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Manual
IMPACT20 CANopen

- System Description
- Configuration
- Mounting and Installation
- LED Diagnostics
- CANopen Bus System
- Technical Data

Publisher's Note

CANopen	IMPACT20 C DI16	Article Number: 56 904
	IMPACT20 C DI8 DO8	Article Number: 56 905
	IMPACT20 C DO16	Article Number: 56 906

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Service and Support

Website:

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In addition, our Customer Service Center (CSC) will be glad to assist you:

Our Customer Service Center can support you throughout your project: during planning and the conception of customer applications, configuration, installation, and startup. We also offer competent consulting or – in more complex cases – we even provide direct onsite support.

The Customer Service Center provides support tools. They perform measurements for fieldbus systems, such as PROFIBUS DP, DeviceNet, CANopen, and AS interface, as well as energy, heat, and EMC measurements.

Our coworkers at the Customer Service Center provide their competence, know-how, and years of experience. They are knowledgeable about hardware and software, and compatibility with products made by various manufacturers.

You can contact the Customer Service Center at

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or by email at csc@murrelektronik.de.

About the User Manual and its Layout

Bus Manual:
General explanations and functions for each bus.

On this subject, please click on the links to the next page.

System/Product Manuals:
Describe the system and product-specific features.

Art. No.	Designation
56931	IMPACT20 Profibus
56932	IMPACT20 CanOpen
56933	IMPACT20 DeviceNet
56934	IMPACT20 EtherCat
56935	IMPACT20 EtherNet/IP
56936	IMPACT20 ProfiNet

www.murrelektronik.com

The following links will provide you with more information on bus systems, as well as the standards and specifications on which they are based:

>>> CANopen (www.can-cia.org)

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Important Information

Minimum Basic Knowledge Requirements

This manual contains general information on the system and the product. For more details, refer to the bus manuals (see Seite III).

To understand this manual, you need to have knowledge about automation systems.

Symbols and Icons

This manual contains information and instructions you must comply with in order to maintain safety and avoid personal injury or damage to property. They are identified as follows:

Notes indicate important information.

Warnings contain information that, if you ignore this information, may cause damage to equipment or other assets or, if you fail to comply with safety precautions, may constitute a danger to the user's health and life.

➔ ***Refer to our catalog or visit our inline shop at www.murrelektronik.com***.

Intended Purpose

Before starting the devices, read this manual carefully. Keep it in a location that is accessible to all users at all times.

The products that are described in this manual were developed, manufactured, tested, and documented in compliance with the relevant safety standards. In normal cases, these products do not constitute any danger to persons or objects, provided the handling specifications and safety instructions described in this manual are observed. They meet the specifications of the European EMC Directive (2004/108/EC).

WARNING

Devices from the IMPACT20 series are not safety devices conforming to the relevant standards.

Do not use the OFF state of the outputs to implement safety-related requirements of the system/machine.

The products are designed for industrial use. An industrial environment is defined as one in which loads are not connected directly to the public low-voltage power grid. Additional measures must be taken if the products are used in private, business, or trade environments.

The safe, troublefree functioning of the products requires proper transportation, storage, mounting, and careful operation. Operation of the devices for their intended purposes is only guaranteed when the devices are fully mounted.

Current safety and accident prevention laws valid for a specific application must be observed for the configuration, installation, setup, maintenance, and testing of the devices. The power supply must comply with SELV or PELV. Power sources in accordance with EN 61558-2-6 (transformer) or EN 60950-1 (switched-mode power supply) meet these requirements.

Only use cables that meet the requirements and regulations for safety, electromagnetic compatibility, and, if necessary, telecommunications terminal equipment specifications.

Information on cables and accessories made by Murrelektronik GmbH for this product is contained in Chapter Accessories.

Qualified Personnel

Only qualified, trained electricians knowledgeable in the safety standards of automation systems may configure, install, set up, maintain, and test the devices. The requirements concerning qualified personnel are dependent on the requirements profiles described in ZVEI and VDMA. For this reason, electricians must know the contents of the manual "Weiterbildung in der Automatisierung" (Further Training in Automation Systems) issued by ZVEI and VDMA and published by Maschinenbau-Verlag, Post Box 710864, 60498 Frankfurt, Germany) before installing and maintaining the devices. They are therefore electricians who are capable of assessing the work executed and any possible dangers arising from this due to their professional training, knowledge, experience, and their knowledge of the pertinent standards; or who have a level of knowledge equivalent to professional training due to their many years of activity in a comparable field.

Only Murrelektronik technical personnel are allowed to execute work on the hardware and software of our devices, if they are devices not described in this manual.

Unqualified tampering with the hardware or software, or failure to observe the warnings cited in this manual may result in severe personal injury or damage to property.

1 System Description

1.1 Description of IMPACT20 Systems

Impact20 is a compact Murrelektronik fieldbus I/O station. It combines 16 inputs or outputs in a very confined space. Due to its small dimensions, the Impact20 is ideal for use in switch cabinets, terminal boxes, and control panels. An Impact20 device comprises a bus interface and a fixed number of I/O slots. The I/O functions are module-dependent and are not modifiable. All connections are implemented using spring-loaded clamping terminals. They are clearly arranged so that functional relationships are logically recognizable.

Fieldbus Protocols

Impact20 is supplied for the following fieldbus protocols:

- PROFIBUS
- CANopen
- DeviceNet
- EtherCAT
- Ethernet/IP
- ProfiNet

Module variants

- Module with 16 inputs
- Module with 8 inputs and 8 outputs
- Module with 16 outputs

Functions

- Easy to recognize, directly assigned status and diagnostic LEDs
- Clear, unmistakable slot designation
- Signal identification on the module
- Terminal-specific disconnection in the event of an error
- Group diagnostic and single-channel short-circuit diagnostic over the bus

1.2 System Components

1.2.1 Product Designation Code

The designation format of IMPACT20 system components explains their function.

Examples:

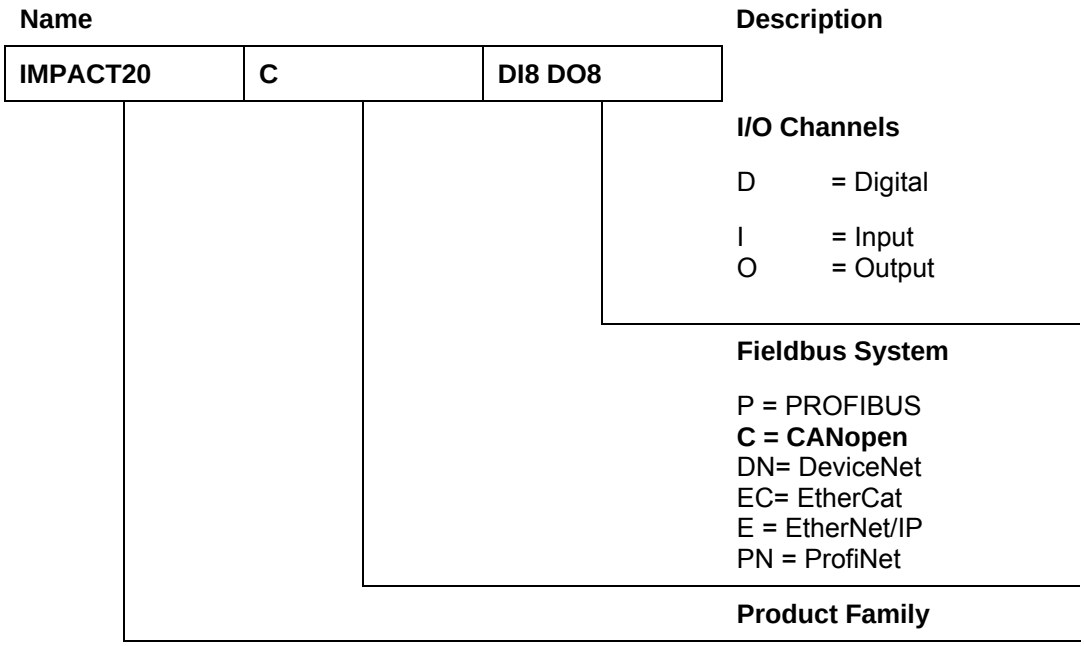

Fig. 1: Example of product designation

1.2.2 Bus Slaves

The function of the IMPACT20 System is to group I/O level signals decentrally and supply this information over a fieldbus network (e.g. CANopen).

Article Number	Description
56 904	IMPACT20 C DI16
56 905	IMPACT20 C DI8 DO8
56 906	IMPACT20 C DO16

Table 1: CANopen fieldbus module

1.3 The IMPACT20 System in the Bus Network

The IMPACT20 System is an I/O system for use in switch cabinets (IP20) for the decentralized capture and control of digital process units. It comprises fieldbus-specific slaves with I/O functions.

1.3.1 System Design Principle

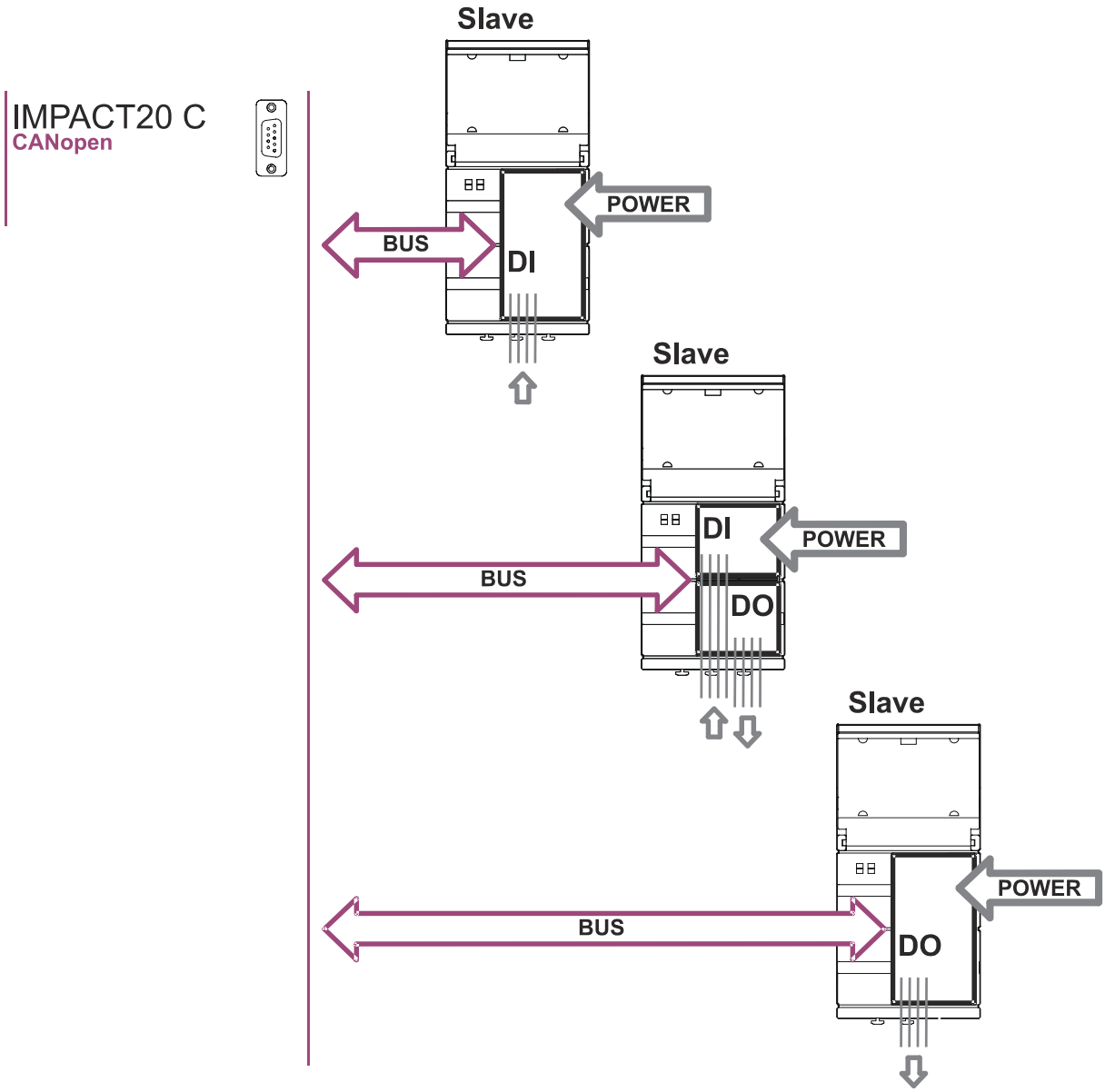

Fig. 2: System Design Principle

1.3.2 Terminal Overviews of Impact20 Modules

1.3.2.1 DI16 Modules

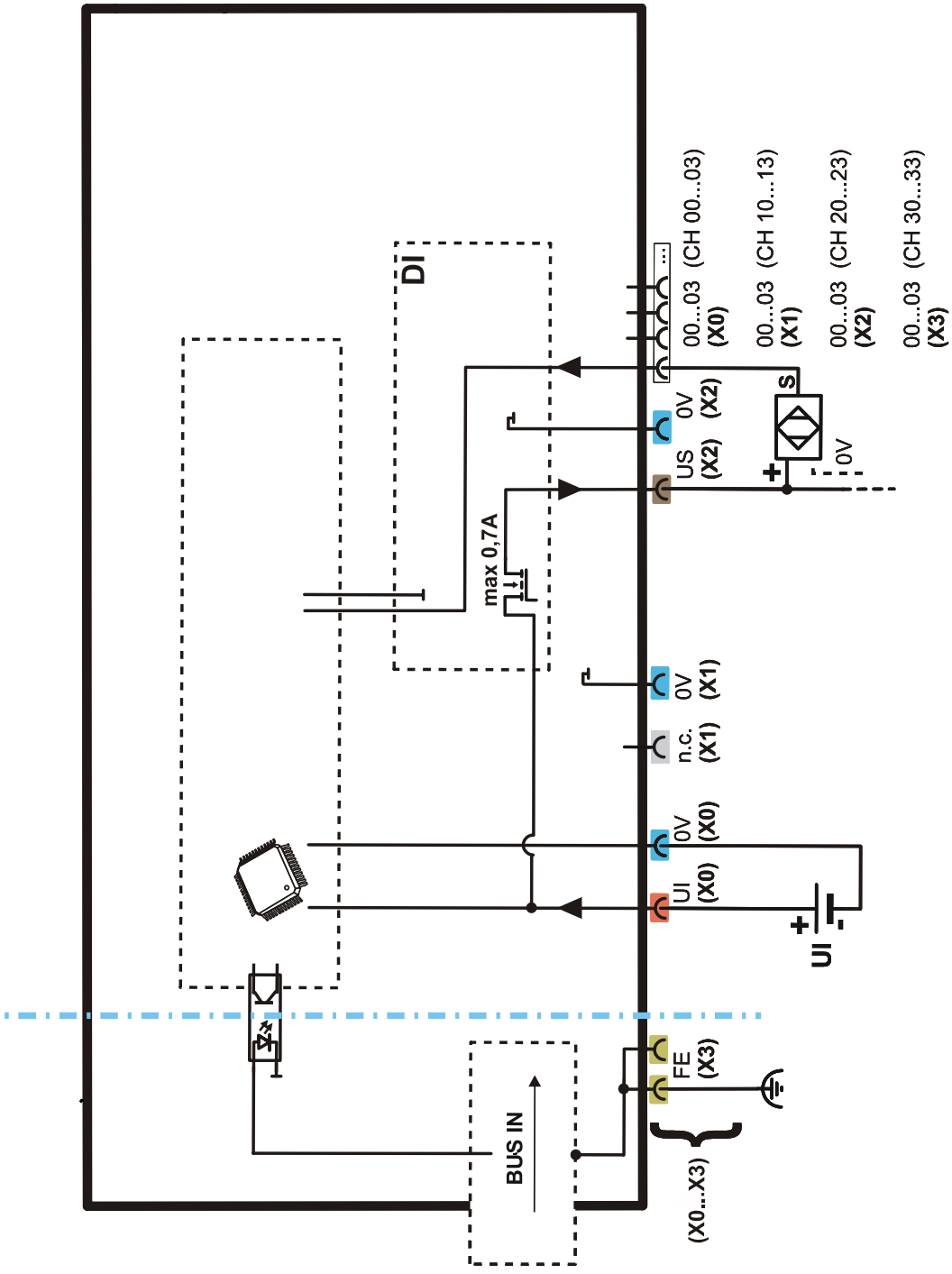

Fig. 3: Terminal Overview of Impact20 DI16 Modules

1.3.2.2 DI8 DO8 Modules

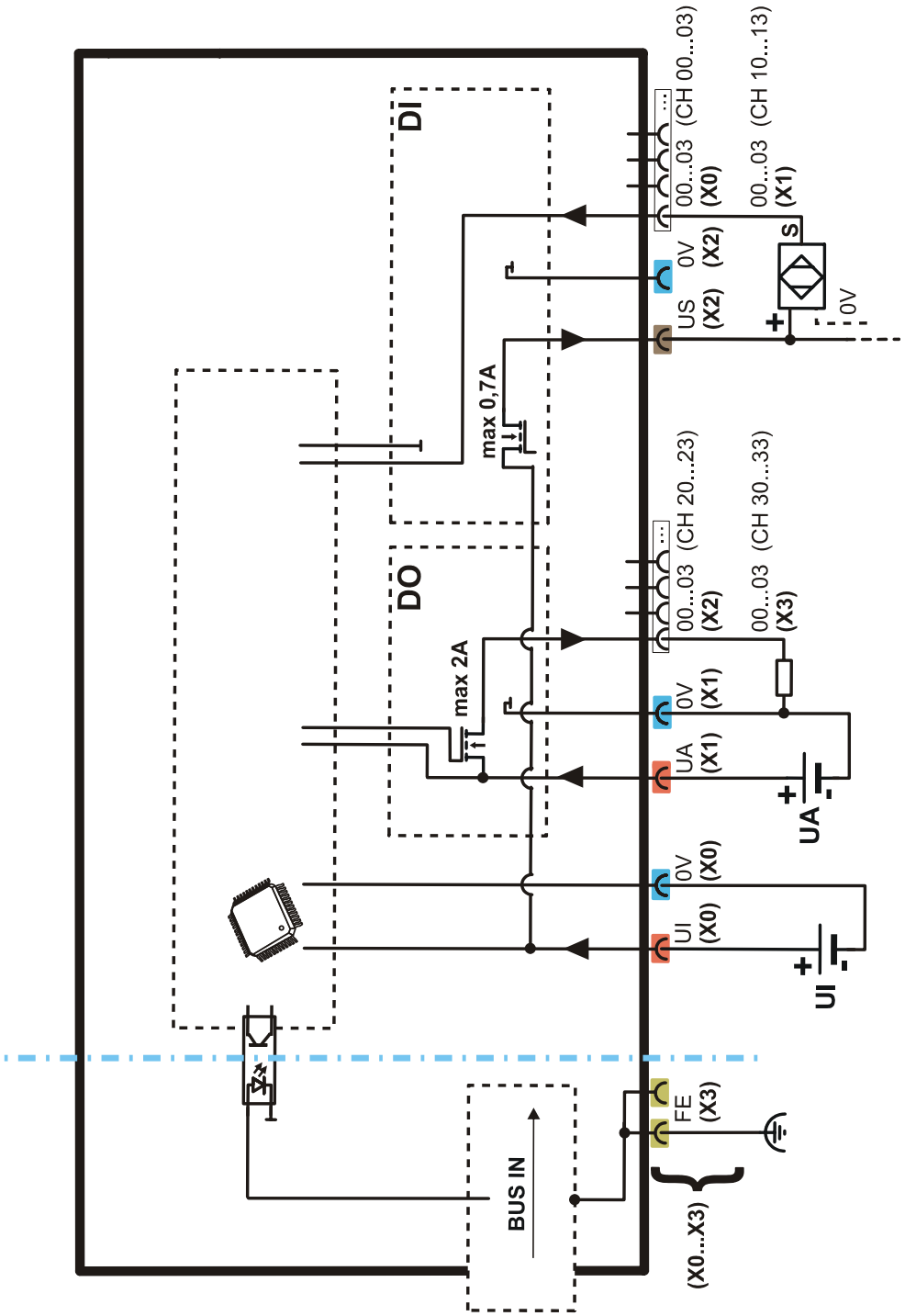

Fig. 4: Terminal Overview of Impact20 DI8DO8 Modules

1.3.2.3 DO16 Modules

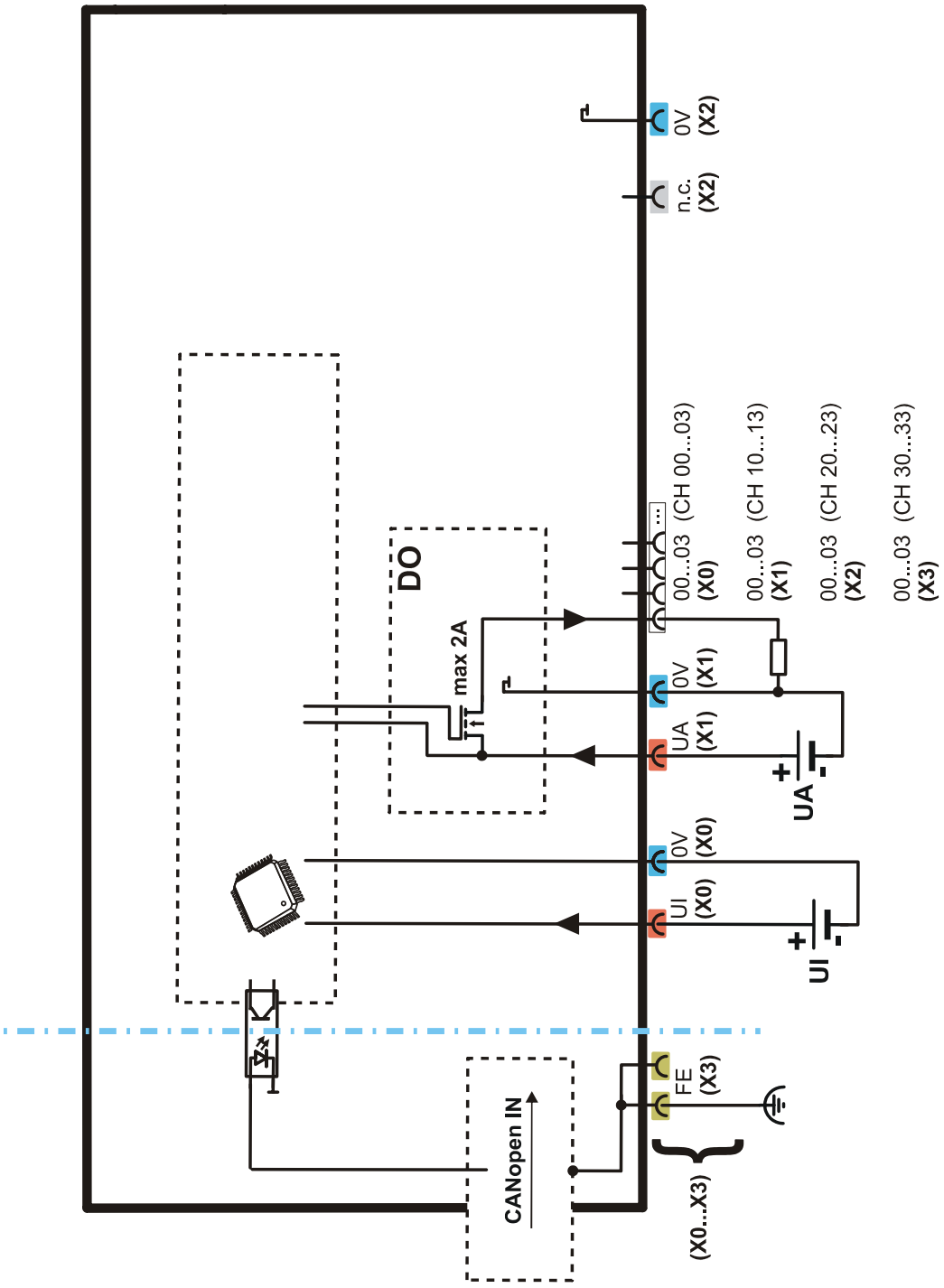

Fig. 5: Terminal Overview of Impact20 DO16 Modules

2 Configuration

This chapter contains information that is relevant during the electromechanical planning phase.

2.1 Power Supply

2.1.1 Configuration Notes

Bus modules require a DC voltage power supply of typically 24 VDC (SELV / PELV) that must comply with the regulations for conventional industrial power supplies.

To optimize immunity from interference, we advise you to tap sensor, bus, and actuator power supply from a number of different power sources. Primary switched-mode or regulated power supplies should be used.

Power supply unit performance is dependent on the number and power requirements of the connected users.

In any case, make sure that the system voltage – measured at the most remote slave – does not drop below 18 VDC when viewed from the system power supplies. System behavior becomes undefined is the sensor and bus power supply drops below 18 VDC. Impact20 modules then generate an undervoltage diagnostic visually and over the fieldbus.

Primary switched-mode power supply units generally permit an increase in output voltage via nominal voltage in order to compensate for line losses.

Modules with digital inputs support the direct connection of commercially available sensors. Depending on the total power requirements resulting from the number of slaves or the use of sensors with high power consumption, a separate power supply may be required for the sensors.

2.2 Galvanic Isolation

To optimize electromagnetic compatibility and increase bus stability, the bus must be galvanically isolated from the remaining electronics.

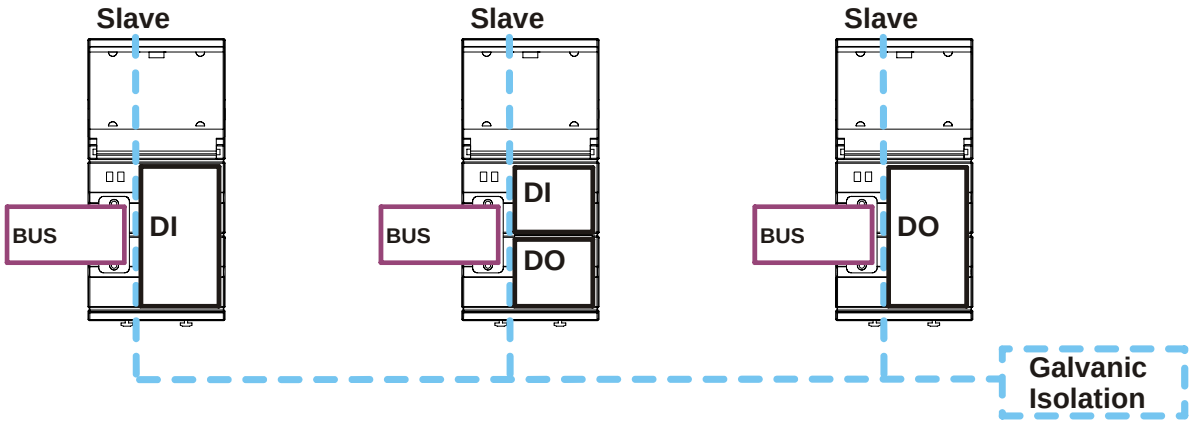

Fig. 6: Impact20 Modules – Galvanic Isolation

2.3 Recommended Power Supply Units

Primary switched-mode power supply units from Murrelektronik are specially designed to power automation systems. For this reason, we recommend this system type to power modules.

Phases	Output power	Input voltage 95 to 132 VAC	Input voltage 185 to 265 VAC
1	240 W / 10 A	85086	85085
1	480 W / 20 A	85088	85087

Table 2: Recommended Power Supply Units, MCSPower+ Single-Phase

Phases	Output power	Input voltage 3 x 340 to 460 VAC
3	240 W / 10 A	85095
3	480 W / 20 A	85097
3	960 W / 40 A	85099

Table 3: Recommended Power Supply Units, MCSPower+ Three-Phase

➔ ***Murrelektronik offers a comprehensive selection of primary switched-mode power supply units.***
Refer to our catalog or visit our inline shop at www.murrelektronik.com.

2.4 Wire Cross-Sections

AWG	mm²
25	0.14
24	0.25
22	0.34
21	0.5
20	0.75
19	0.75
18	1
16	1.5
14	2.5

Table 4: Converting wire cross-sections

Refer here to Fig. 14: Wiring terminals

2.5 Electromagnetic Compatibility (EMC)

The units comply with the requirements of EC Directive 2004/108/EC "Electromagnetic Compatibility".

These are units conformant with Class A devices. They may cause radio interference in residential areas. In this case, the operator may be required to implement suitable countermeasures.

The devices described in this manual meet the relevant standards for electromagnetic compatibility in themselves. However, this does not assume that their electromagnetic compatibility is also guaranteed when built into a system.

For this reason, the user is urgently advised to observe the instructions below concerning installation in accordance with EMC requirements.

Protection against Electrostatic Discharge

The products described in this manual contain complete semiconductor components that may be destroyed or damaged by electrostatic discharge (ESD).

Damage does not necessarily lead to an immediately detectable failure or malfunction. However, it may become evident with a delayed reaction or sporadically.

When handling these devices, make sure that the safety precautions for ESD-sensitive devices that are well-known in general practice are maintained. In particular, note the following items:

Do not disconnect or connect plugs or connectors live.

The person handling the devices must discharge themselves electrostatically before they come in direct contact with the devices, e.g. by touching a grounded part of the system, or by wearing an ESD antistatic wrist strap connected to ground.

Grounding

A short (as short as possible) low-impedance connection is required between the grounding point and reference ground to discharge interference voltages that act between the device and reference ground.

The inductance of standard FE lines represents a high impedance for high-frequency interference voltages.

Make sure that the DIN mounting rail, on which the device is mounted, has a low-impedance connection to ground.

Wiring Arrangement

Avoid EMC problems by keeping to the following basic rules of wiring arrangement:

- Route the data wiring at the greatest possible distance from the power lines. Keep a minimum distance of 10 cm.
- Only cross data and power lines at right angles.
- Route data wires and power cables in separate, shielded ducts.
- Take into consideration the potential interference of other devices or wires when arranging wires.
- Keep the greatest possible distance from frequency converters, motor cables, and other devices, and from cables that emit high-frequency interference.

Power Failures and Dips

Transient power failures and dips (<10 ms) do not normally impair operation since the power supply to the electronics is buffered by integrated capacitors. However, this does not apply to the power supply of sensors and actuators connected to the module. Their high power demand can not be met by capacitors integrated in the device. For this reason, short-term interruptions in actuator voltage may cause undesired switching operations.

If the input signal of less than 1 ms changes, integrated input filters prevent any change to the input state reported to the controller. Longer interruptions to sensor power supply may lead to an input signal change.

Separate Powers Supplies

Sensors and actuators can be powered by a separate power supply unit. A separate power supply improves the electromagnetic compatibility of the overall system.

Suppression of Inductive Loads

The outputs of the devices described in this manual have an integrated protection circuit against high-energy interference voltages, e.g. that occur when inductive loads are switched.

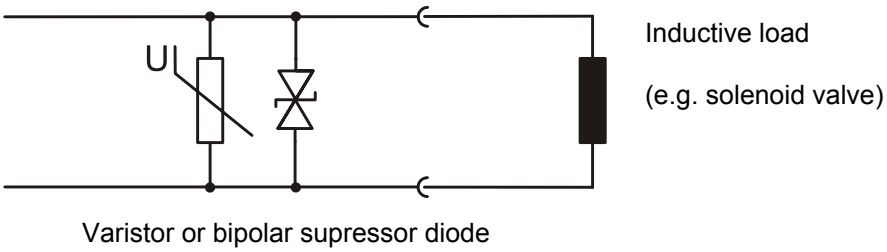

Fig. 7: Suppression of Inductive Loads

A supressor diode guarantees a rapid reduction in the energy stored in the magnetic field of an inductive load. However, with inductive loads, in particular loads within the maximum current carrying capacity range of a channel and at switching frequencies > 1 Hz, we advise the use of commercially available protection circuits that are capable of reducing the energy stored in the connected inductances.

The high voltages when inductive loads are switched off generate strong fields in the wiring and this may lead to interference in adjacent circuits or devices.

➔ ***Murrelektronik offers a comprehensive selection of suppressor products.*** Refer to our catalog or visit our inline shop at ***www.murrelektronik.com***

Other Measures and Limits

In specific system configurations, the requirements for interference emission and immunity from interference can only be met with additional measures since the EMC within a system is dependent on the individual components made by other manufacturers.

Mains filters are a suitable measure to reduce cable-bound interference. Various manufacturers offers optical-fiber converters. This type of data transmission is basically immune to EMC interference. However, it does not apply to the converter electronics. Therefore, use of fiber-optics does not eliminate all EMC problems.

Our accredited test center will answer any further queries you may have concerning EMC. There you will receive advice on certain methods to conform with the EMC Directive for the systems you have built.

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2.6 Connecting Sensors and Actuators

WARNING

Devices from the IMPACT20 series are not safety devices conforming to the relevant standards.

Do not use the OFF state of the outputs to implement safety-related requirements of the system/machine.

2.6.1 Sensor Power Supply

Sensor can be powered by the IMPACT20 module. The sensor power supply is protected by a self-resetting short-circuit proof transistor for each module. The maximum current draw for the sensor power supply is 0.7 A per module.

2.6.2 Actuators

The maximum current draw of Impact20 modules is 2 A per channel. Please remember that the max. total current of 8 A at the UA terminal must not be exceeded.

CAUTION

The module may be damaged if the actuator power supply polarity is reversed.

In order to reactivate an output after a short-circuit or overload has been rectified, the following procedure must be observed:

1. Set output 1 to "0".

2. Set output to "1"

or

1. Switch off voltage at UA.

2. Switch on voltage at UA.

2.6.3 Overview of Channel Assignment

Row	16 DI			
X0	00 (DI)	01 (DI)	02 (DI)	03 (DI)
	CH 00	CH 01	CH 02	CH 03
X1	00 (DI)	01 (DI)	02 (DI)	03 (DI)
	CH 10	CH 11	CH 12	CH 13
X2	00 (DI)	01 (DI)	02 (DI)	03 (DI)
	CH 20	CH 21	CH 22	CH 23
X3	00 (DI)	01 (DI)	02 (DI)	03 (DI)
	CH 30	CH 31	CH 32	CH 33
	24 V / current as per input characteristic Type 3			

Table 5: Channel assignment for DI modules

Row	16 DO			
X0	00 (DO)	01 (DO)	02 (DO)	03 (DO)
	CH 00	CH 01	CH 02	CH 03
X1	00 (DO)	01 (DO)	02 (DO)	03 (DO)
	CH 10	CH 11	CH 12	CH 13
X2	00 (DO)	01 (DO)	02 (DO)	03 (DO)
	CH 20	CH 21	CH 22	CH 23
X3	00 (DO)	01 (DO)	02 (DO)	03 (DO)
	CH 30	CH 31	CH 32	CH 33
	24 V / max. 2			

Table 6: Channel assignment for DO modules

Row	DI8 / DO8			
X0	00 (DI)	01 (DI)	02 (DI)	03 (DI)
	CH 00	CH 01	CH 02	CH 03
X1	00 (DI)	01 (DI)	02 (DI)	03 (DI)
	CH 10	CH 11	CH 12	CH 13
X2	00 (DO)	01 (DO)	02 (DO)	03 (DO)
	CH 20	CH 21	CH 22	CH 23
X3	00 (DO)	01 (DO)	02 (DO)	03 (DO)
	CH 30	CH 31	CH 32	CH 33
	DI: 24 V / current as per input characteristic Type 3 DO: 24 V / max. 2			

Table 7: Channel assignment for DIDO modules

3 Mounting and Installation

3.1 Mounting

3.1.1 Dimensioning

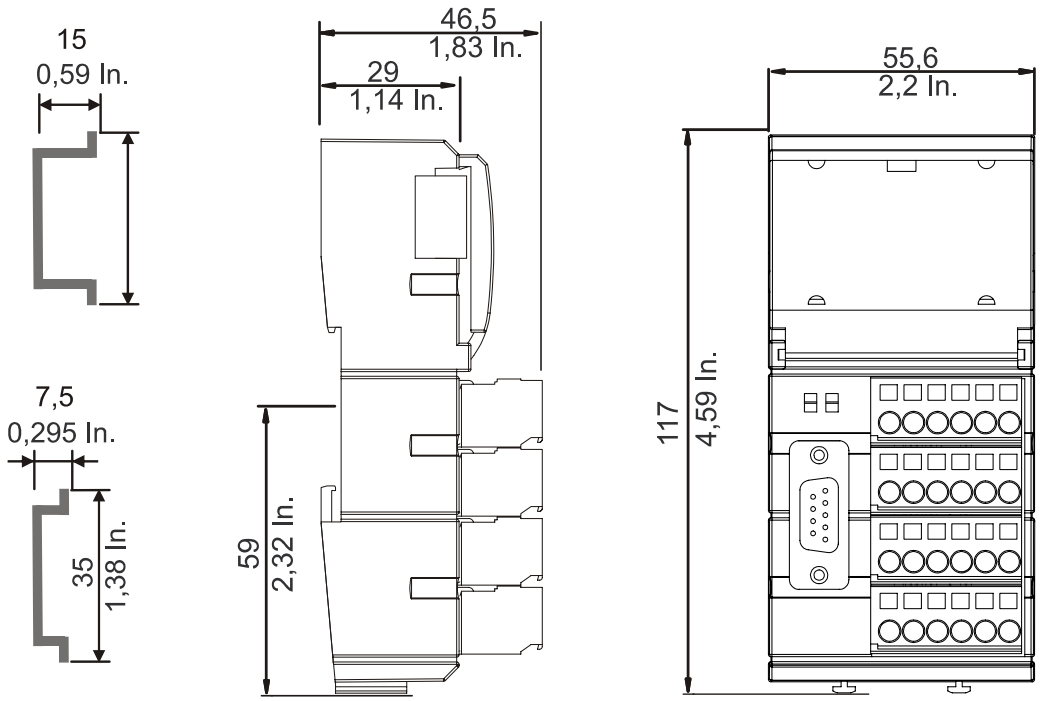


Fig. 8: Dimensioning

The dimensions of all IMPACT20 modules are identical.

3.1.2 Distances

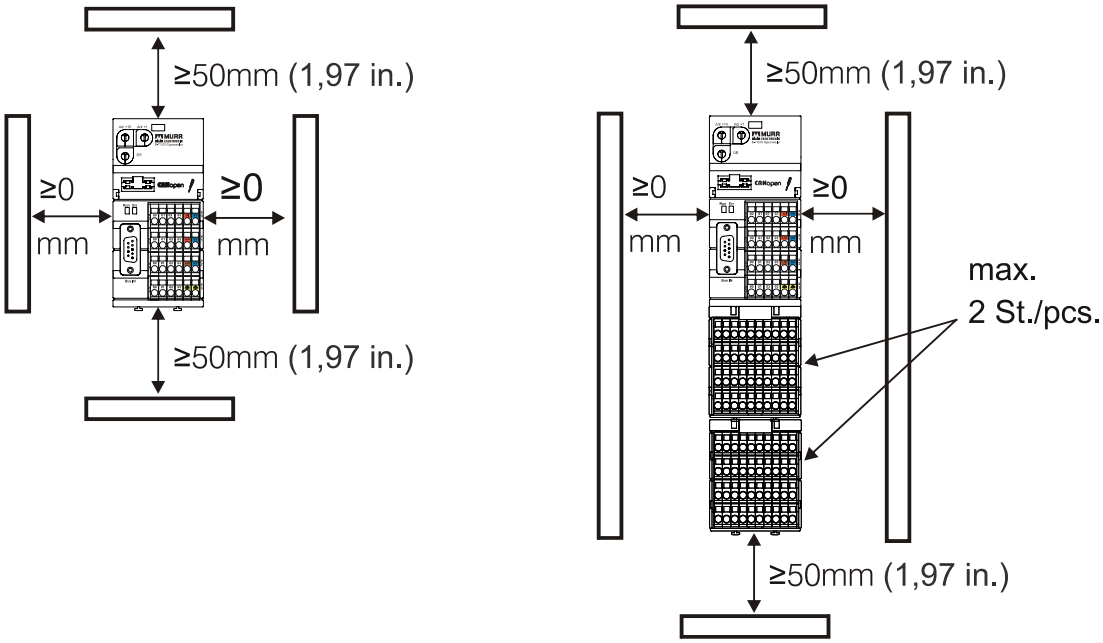


Fig. 9: Distances

3.1.3 Installation Position

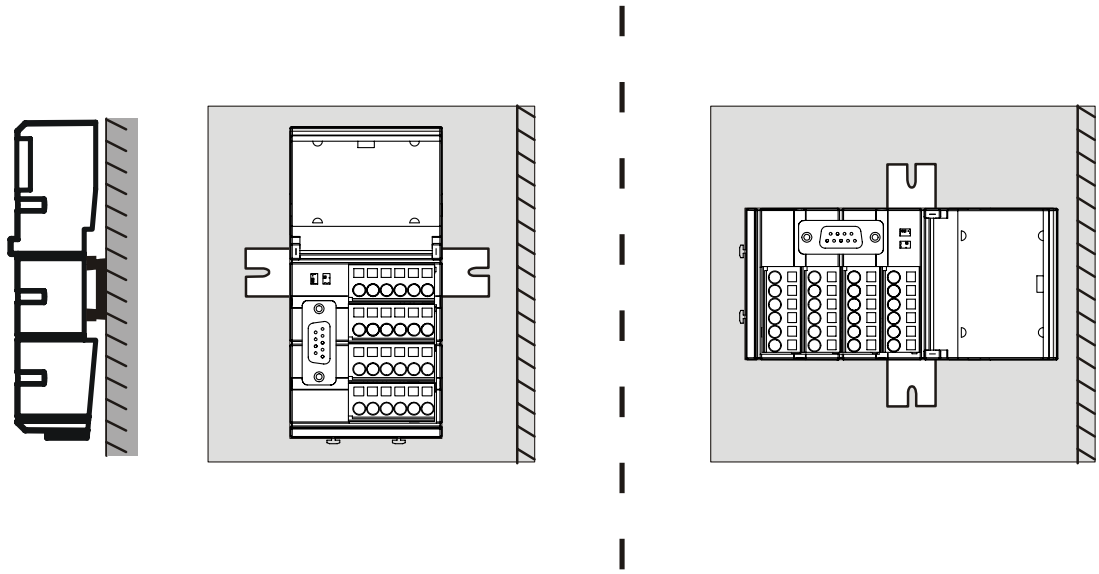


Fig. 10: Installation position

3.1.4 Mounting IMPACT20 Modules on DIN Mounting Rails

Make sure that the DIN mounting rail, on which the device is mounted, has a low-impedance connection to ground.

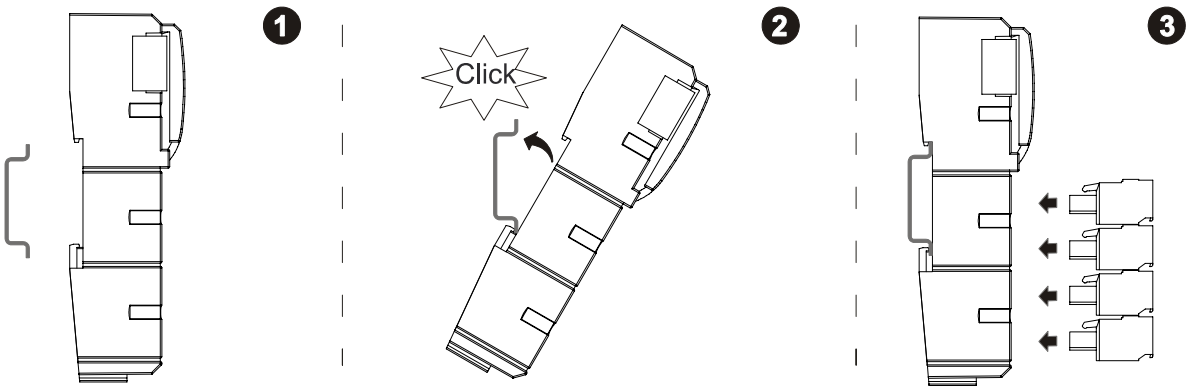


Fig. 11: Mounting IMPACT20 modules on DIN mounting rails

3.1.5 Removing Terminals

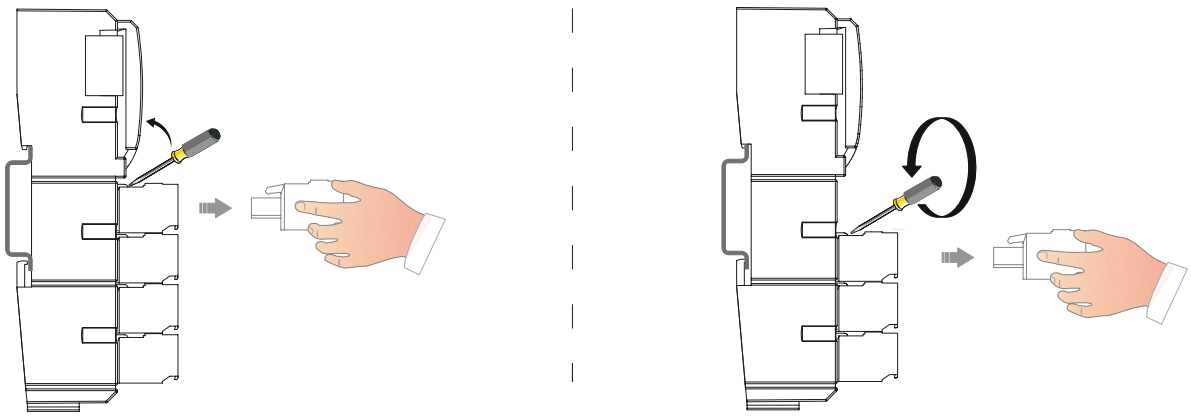


Fig. 12: Removing terminals

3.2 Installation

3.2.1 Terminal Connection

3.2.1.1 Labeling Terminals / Terminal Overview

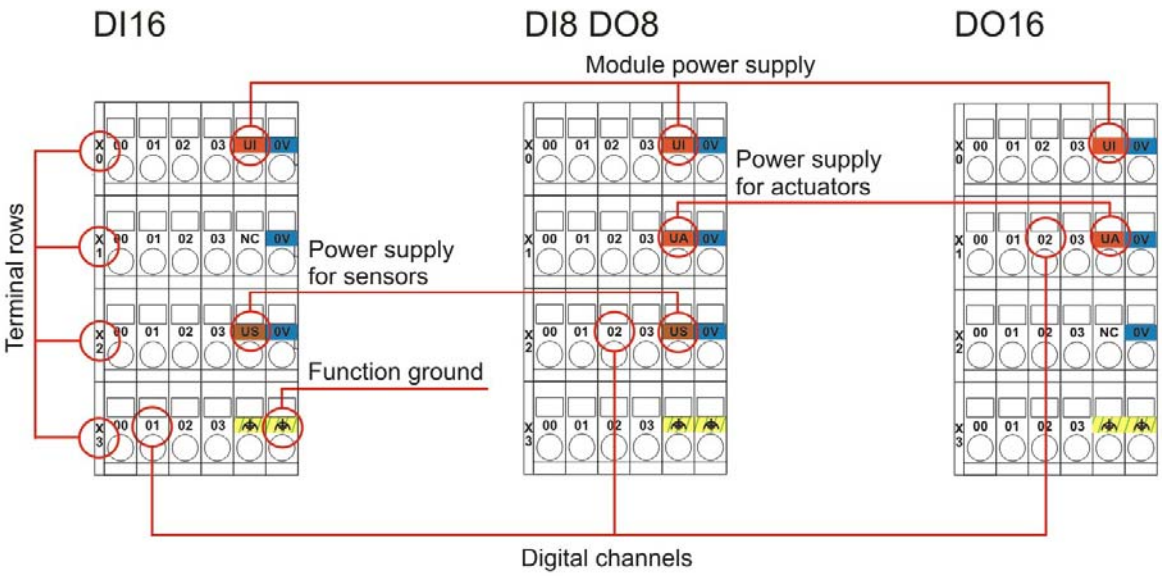


Fig. 13: Labeling terminals

UI	Supply voltage for internal module power supply / sensor power supply.
NC	Not connected
UA	Power supply for actuators
US	Power supply for sensors. The US terminal obtains its energy from the UI terminal at a max. current of 700 mA.
0 V	0 Volt potential
⏚	Function ground
X0 to X3	Designation of up to 4 terminal rows, where the topmost starts with X0.
00 to 03	Digital channels (inputs and outputs) The labeling also corresponds to the channel number and bit position.

➔ ***Murrelektronik supplies label sheets Art. No. 56113 for the simple labeling of terminals. Refer to our catalog or visit our inline shop at www.murrelektronik.com***

3.2.1.2 Wiring Terminals

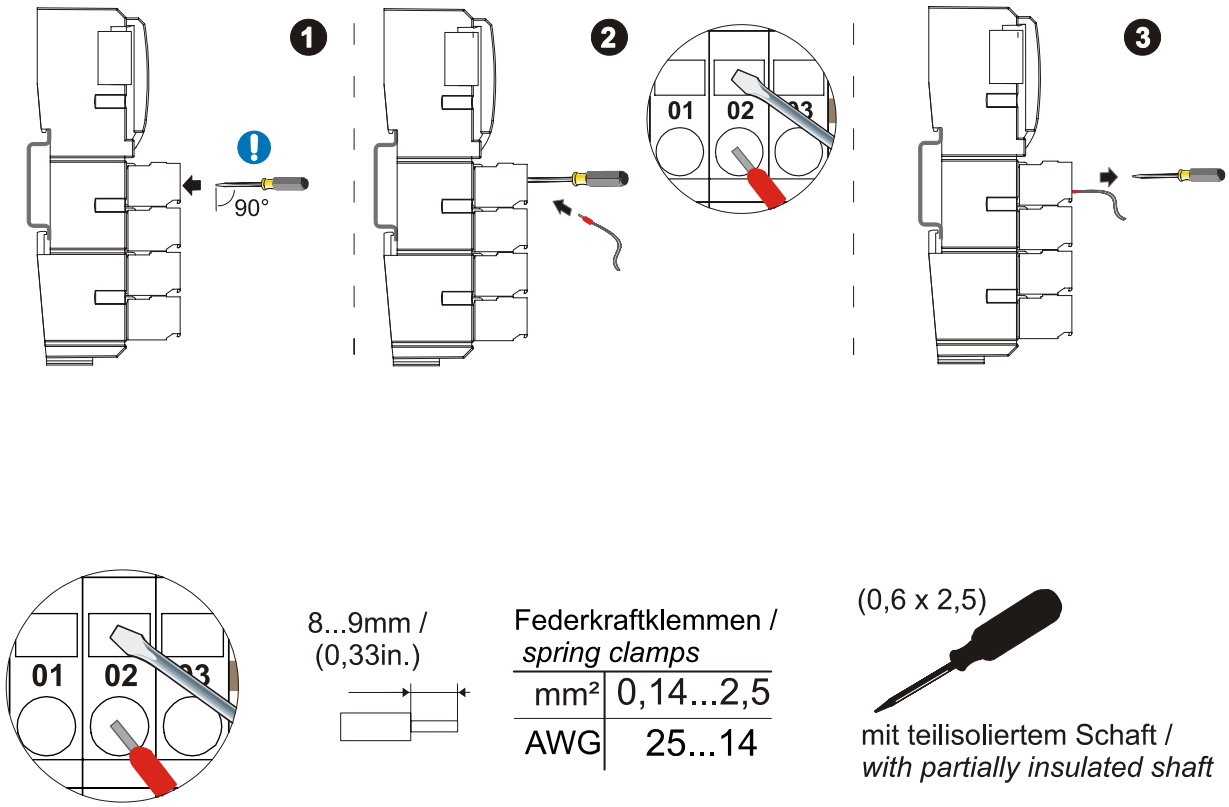


Fig. 14: Wiring terminals

Refer here to Table 4: Converting wire cross-sections

4 LED Diagnostics

The fieldbus diagnostics and the function of the bus LED is described in the chapters relating to the field buses.

The following diagnostics are displayed visually and signaled over the fieldbus:

- Sensor short-circuit as group signal
- Actuator short-circuit by channel and group signal
- Module power supply undervoltage UI (module power supply is less than 18 V).
- Actuator power supply undervoltage UA (actuator power supply is less than 18 V).

4.1 LED Indicators

All IMPACT20 modules have separate well-arranged LEDs to indicate device and I/O status. These displays are located on the front of the device.

4.1.1 LED for Module and Actuator Power Supply

An LED is provided for each of the module power supply terminals "UI" and actuator power supply terminals "UA". They light up red for undervoltage (< 18 V) and green in normal state (> 18 V).

- The LEDs under "**UI**" indicate the status of the power supply voltage for the internal power supply.

Please note that the sensor power supply voltage (US terminal) is connected internally to the module power supply voltage (UI terminal). This ensures that the two terminals have the same voltage.

- The LEDs under **"UA"** indicate the status of the actuator power supply voltage.

LED display UI and UA	Response	State
	green	Power supply OK (≥ 18 V)
	red	Undervoltage (< 18 V)
	off	Voltage ≤ approx. 12 V

Table 8: LED module power supply

4.1.2 LED for Sensor Power Supply

- The LEDs under **"US"** indicate the status of the sensor power supply voltage.

LED Display US	Response	State
	off	Power supply OK only if UI > 18V
	red	Overload or short-circuit of sensor power supply.

Table 9: LED periphery power supply

4.1.3 Signal-Logic Display and LED Behavior

Each input and output is assigned a separate status display This is labeled **"00 to 03"**. The label indicates the channel number and bit position. It is arranged under the associated terminal and assigns the status of the peripheral components.

Relationship of signal-logic display and LED behavior at the input

LED Display		Logic Value	Voltage at Input	Signal
	off	0	< 11 V	Input with NO contact function
	yellow	1	11 to 30.2 V (dependent on US)	

Table 10: LED at input of digital modules

Relationship of signal-logic display and LED behavior at the output

LED Display		Logic Value	Voltage at output	Signal
	off	0	0 V	Output
	yellow	1	12 to 30.2 V (dependent on UA)	
	red	1	-	Output in overload / short-circuit case

Table 11: LED at output of digital modules

4.2 Short-Circuit or Overload of Sensor Power Supply US

Reaction of IMPACT20 modules to short-circuit or overload of sensor power supply:

- The diagnostic LEDs light up red on the associated terminal.
- The bus transmits the diagnostic data to the Master.

After rectification of the overload or short-circuit, the sensor power supply is immediately available again.

4.3 Threshold Values of Module Power Supply

There are three thresholds for undervoltage detection:

12 V < UI < 18 V	The device continues to function but • The UI LED lights up red. • The respective diagnostic was transferred to the Master.
7 V < UI < 12 V	The bus communication still functions but: All outputs are reset to 0.
6 V < UI < 7 V	The device performs a power reset.

4.4 Short-Circuit or Overload of Actuators

Reaction of IMPACT20 modules to short-circuit or overload:

- The diagnostic LEDs light up red on the associated terminal.
- The respective diagnostic data are transferred over the bus to the Master.

In order to reactivate an output after a short-circuit or overload has been rectified, the following procedure must be observed:

1. Set output 1 to "0".

2. Set output to "1"

or

1. Switch off voltage at UA.

2. Switch on voltage at UA.

4.5 Undervoltage of Actuator Power Supply UA

There are two thresholds of undervoltage detection:

12 V < UA < 18 V	The device continues to function but • The UA LED lights up red. • The respective diagnostic was transferred to the Master.
0 V < UA < 12 V	The bus communication still functions but: • The UA LED goes out. • All outputs are reset to 0.

5 CANopen Bus System

5.1 Description of the CAN Bus Protocol

In the CAN system (Controller Area Network), equal rights users (control devices, sensors, and actuators) are interconnected by means of a serial bus. The bus cable itself is a symmetrical or asymmetrical two-wire cable that is either shielded or unshielded, depending on the requirements. The electrical parameters of physical transmission are defined in ISO 11898.

In CAN data transfer, it is not the stations that are addressed but messages. These “addresses”, also referred to as identifiers, are marked by a network-wide unique identifier. In addition to identifying content, the identifier also establishes message priority. This is essential for bus assignment when several stations compete for access rights.

To be able to process all transmission requests in a CAN network while complying with latency conditions at possibly low baud rates, the CAN protocol must implement a bus assignment method (arbitration). This method guarantees that simultaneous bus access by several stations always leads to defined bus assignment. Through bit-wise bus assignment (CSMA/CA process) based on the identifiers of transferred messages, collision between several transmission-ready stations is clearly resolved, at the latest after 13 (standard format) or 33 bit times (expanded format) of any random time bus access. This destruction-free collision resolving method guarantees that bus capacity is only required when user information is transferred. This also applied to bus overload.

High system and configuration flexibility is achieved, thanks to the above-described content-related method of addressing. Further stations (receiver) can be easily added to the existing CAN network without changing the software or hardware on the existing stations. As the data transfer protocol does not stipulate any physical target addresses for individual components, the concept of modular electronics is supported, as well as the possibility of multi-reception (broadcast/multicast) and the synchronization of distributed processes.

5.2 Description of CANopen Protocol

The CANopen profile family is based on a so-called “Communication profile” which specifies the underlying communication mechanisms and their description (DS301). The most important device types being used in industrial automation technology, such as digital and analog I/O modules (DS401), drives (DS402), operating devices (DSP403), regulators (DSP404), programmable controllers (DS405), encoders (DS406), are described in so-called “Device profiles”. The device profiles define the functionality of standard devices of that particular type. The configurability of devices via the CAN-Bus serves as the basis for the manufacturer independence that the profile family aspires to provide.

CANopen is a collection of profiles for CAN-based systems with the following characteristics:

- open
- real-time data transfer without protocol overhead
- modular,
- scalable,
- devices are interoperable and exchangeable,
- supported by many international manufacturers,
- standardized network configuration,
- access to all device parameters
- synchronizable,
- cyclical and/or event-oriented process data traffic (short system reaction time) possible.

5.3 General Information on CANopen

5.3.1 Object Directory Structure

CANopen assigns a basic functionality to each device. It is possible to assign further functions that, however, must conform to the specifications in the device and communication profile. The device characteristics are specified in the object directory. The object directory is created in the device's range of application.

The object directory structure is depicted in the table below. Communication profile data is located in the range between 1000H and 1FFFH and the device profile data between 6000H and 9FFFH. The two sections are highlighted in gray in the table.

Index	Object
0000	Not used
0001 - 001F	Static Data Types
0020 - 003F	Complex Data Types
0040 - 005F	Manufacturer-Specific Data Types
0060 - 025F	Device Profile-Specific Data Types
0260 - 0FFF	Reserved for further use
1000 - 1FFF	Communication Profile Area
2000 - 5FFF	Manufacturer-Specific Profile Area
6000 - 9FFF	Standardized Device Profile Area
A000 - AFFF	Standardized Network Variable Area
B000 - BFFF	Standardized System Variable Area
C000 - FFFF	Reserved for further use

Table 12: Object directory structure

Use the index to access entries in the object directory. The index addresses the entire data format. A given element can be selected from the data structure by means of the subindex. An example of the addressing structure is illustrated in the table below.

Index	Subindex	Description
6000H	0	Number of entries (here 2)
	1	Inputs 0 to 7
	2	Inputs 10 to 17

Table 13: Use of index and subindex

5.3.2 General Description of the Communication Profile

The communication profile is based on the services and protocols provided by the CAN Application Layer (CAL). It contains functions for distributed synchronous operation, provides a common time base and defines a uniform error signal flow. Application objects assignable to communication objects. The communication profile also establishes system initialization. The CANopen communication model differentiates between four different types of messages (objects):

Administrational Messages (management messages).	They comprise: • Layer management (LMT), • Network management (NMT), • Identifier issuing (DBT). Implementation via CAL management services.
Service Data Messages. (service data)	Service Data Objects (SDO) are used for reading and writing entries in the device object directory. SDOs are implemented by CAL application services. Each CANopen device supports at least one SDO server.
Process Data Messages	• High-speed transmission of Process Data Objects (PDO), • Transmission without additional protocol, • Difference between synchronous and asynchronous transmission, • Realization of PDOs by CAL application services.
Predefined Messages.	There are three predefined communication objects • SYNC, • Time Stamp, • Emergency Object. Support of these objects is not mandatory. Implementation is via CAL application services.

5.3.3 Process Data (PDO) – Description of Transmission Modes

CANopen offers various possibilities for transferring process data. The following transmission types are supported by Impact20 modules:

“Change of State” PDO Transmission (Asynchronous)	“Change of state” refers to the event-controlled changing of an input value. The data is transmitted on the bus immediately after having been modified. The bus bandwidth is optimally used by the event control method, as the entire process image is not constantly being transmitted, but only the modifications of the same. Short reaction times are also achieved, as it is not necessary to wait for the next query by a master when an input value changes. If the “Change of state” PDO transmission is selected, one must remember that, under certain circumstances, multiple events may occur simultaneously and result in delays until a relatively low priority PDO can be transmitted on the bus. Also, a constantly changing input with high priority PDO must be prevented from blocking the bus (“babbling-idiot”). For this reason, event control is disabled for analog inputs (according to CANopen specifications) as a default condition and must be activated with object 0x6421.
"Synchronous" PDO Transmission	It is not only in drive applications that it makes sense to synchronize reading the incoming information with setting the outputs. CANopen supplies the SYNC object for this purpose. This is a high priority CAN telegram with no user data. When it is received, it is used by the synchronized nodes as a trigger to read inputs or set outputs.

5.3.4 Access to the Object Directory via SDO Access

Errors in SDO Access / SDO Abort Codes

If an access error occurs, the IMPACT20 C module transmits a reply with the object to which an access attempt was made. Byte 0 (command specification) contains the value 80H. Bytes 4 to 7 in the SDO comprise the Abort Code, as described in the table below. This is an excerpt from CiA-DS301.

Abort Code	Description
0503 0000h	Toggle bit not alternated
0601 0000h	Unsupported access to an object
0601 0002h	Attempt to write a read only object
0602 0000h	Object does not exist in the object dictionary
0604 0041h	Object cannot be mapped to the PDO
0604 0043h	General parameter incompatibility reason
0604 0047h	General internal incompatibility in the device
0607 0010h	Data type does not match, length of service parameter does not match
0609 0011h	Subindex does not exist
0609 0030h	Value range of parameter exceeded (only for write access)
0609 0031h	Value of parameter written too high
0800 0022h	Data cannot be transferred or stored to the application because of the present device state

Device Profile: General Description

The device profile contains the functionality description of the device. All application objects (functions and parameters) of a device are defined in the device profile. It forms a standardized interface for device functionality. Entries in the object directory are identified through the index. Access to entries is accomplished by means of SDO services which permit entries to be read or written.

Implemented Minimal Device Configuration

The following device configuration is available after the device-internal initialization:

1. Minimal device configuration without dynamic ID distribution. ID assignment is illustrated in the tables below.
2. Static mapping of application objects to PDOs.
3. Synchronous, asynchronous, cyclic, and acyclic PDO transmission with master monitoring during synchronous PDO transmission.
4. Emergency telegrams when an error occurs.
5. CANopen Bootup procedure per NMT services and Node guarding and heartbeat.

Object	Function code (Binary)	Resulting COB-ID		CMS Priority
		(Hex)	(Dec)	
NMT	0000	0	0	0
SYNC	0001	80H	128	0

Table 14: Broadcast object of predefined master-slave connections

Object	Function code (Binary)	Resulting COB-ID		CMS Priority
		(Hex)	(Dec)	
EMERGENCY	0001	81H - FFH	129 - 255	0 , 1
PDO (tx)	0011	181H - 1FFH	385 - 511	1 , 2
PDO (rx)	0100	201H - 27FH	513 - 639	2
PDO (tx)	0101	281H - 2FFH	641 - 767	2 , 3
PDO (rx)	0110	301H - 37FH	769 - 895	3 , 4
SDO (tx)	1011	581H - 5FFH	1409 - 1535	6
SDO (rx)	1100	601H - 67FH	1537 - 1663	6 , 7
Node-Guarding	1110	701H - 77FH	1793 - 1919	-

Table 15: Objects of predefined master-slave connection (as seen from the slave)

5.3.5 CANopen Bootup

In the minimal device equipment, a short boot sequence takes place. This process is illustrated in the figure below.

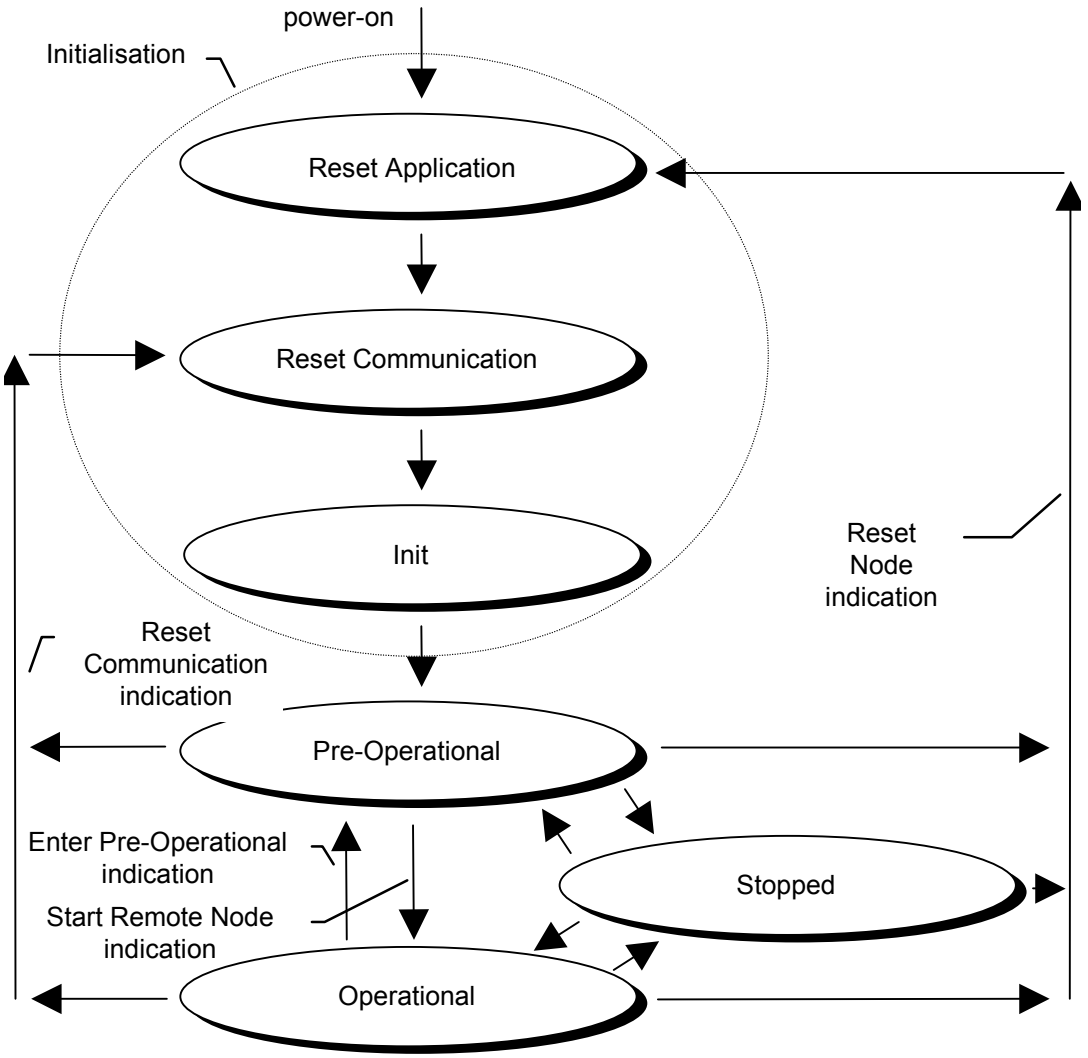


Fig. 15: Status diagram for a CANopen device with minimal device equipment

Reset Application	After a device start or NMT service “Reset node”, the device is in a “Reset application” state. The device profile is initialized in this condition. All device profile entries (objects 6000H – 9FFFH) are then set to the default. When initialization is completed, the device automatically assumes “Reset communication” state.
Reset Communication	This condition is assumed through NMT service “Reset communication” or after “Reset Application”. All parameters (default, according to device configuration) of the supported communication objects (1000H - 1FFFH) are written to the object directory. After this, the device automatically assumes the “Init” state.
INIT	All necessary communication objects (SDO, PDO, SYNC, Emergency) are defined during the “Init" state. The assigned CAL services are set up and the CAN controller is configured accordingly while in this state. With this, device initialization is complete and the device assumes “Pre-Operational” state.
Pre-Operational	The device assumes “Pre-Operational” state after a Reset or through NMT Service “Enter Pre-Operational”. In this state, the device can be reconfigured according to its equipment. Only the SDOs, however, are available to read and write device data. The device waits for a network start after the configuration is complete.
Stopped	NMT service “Node stop” causes the device to assume the “Stopped” state. The device cannot be configured in this condition. No services are available to read and write device data (SDO). Only the slave monitoring (Node Guarding) function remains active.
Operational	Full device functionality can be used if the CANopen network is brought into “Operational” state by NMT service “Node start”. Communication can take place via PDOs and via SDOs as well.

Configuration changes in "Operational " state may have unpredictable impacts on device functions and, in turn, on the system.

Therefore, only carry out configuration changes in "Pre-Operational" state.

5.4 Bus Physics

5.4.1 CAN-Bus System Data

The table below illustrates the most important system data.

Transmission medium	Twisted, shielded three-wire line (Can-H, Can-L, Can-GND)
Network topology	Linear bus structure
Baud rates	Dependent on the cable length (max. 1000 Kbit/s): 1000 Kbit/s 30 m 800 Kbit/s 50 m 500 Kbit/s 100 m 250 Kbit/s 250 m 125 Kbit/s 500 m 50 Kbit/s 1000 m
Transfer duration	134 µs for an 8 byte telegram at 1000 Kbit/s
Number of bus devices	127
Transmitter output current	>25 mA
Number of I/O points	Standard CAN: 16384 bytes (PDO data)
Addresses	One specific address per device in the range from 0 to 128
Access	Multi-master, messages with priorities
User data	8 bytes per telegram
Terminating resistors	120 Ω, always at each end of the data cable
Error recognition	Identification of faulty messages, automatic repetition
Spur line length[1]	Date rate 1000 Kbit/s: Max. spur line length: 0.3 m Cumulative spur line length: 1.5 m Baud rate: 500 Kbit/s: Max. spur line length: 6.0 m Cumulative spur line length: 30 m

Table 16: CAN-Bus System Data

To limit the influence of the reflected wave on signal quality, spur lines should be limited to max. 0.3 m at a baud rate of 1 Mbit/s.

[1] Calculation of the max. spur line length is not part of the scope of this manual.
For further information see CiA-DR303-1.

5.4.2 CAN-Bus Level

In CAN, bus levels are differentiated as dominant and recessive. The dominant bus level overwrites the recessive one. If various bus stations transmit both dominant and recessive bus levels simultaneously, the dominant level establishes itself on the bus. The recessive level can establish itself only if it is transmitted by all bus devices simultaneously. The recessive level is logic “1” (high) and the dominant level is logic “0” (low). When there is no bus transmission traffic, the bus level is recessive.

Every CAN-Bus device must be able to implement the output level variances Vdiff = VCAN_H - VCAN_L shown in the table below. A transmission output current of >25 mA must be possible.

Dominant bus level	Vdiff ≥ 0.9 V
Recessive bus level	Vdiff = -0.5 V to +0.5 V
VCAN_H dominant (nominal)	3.5 V
VCAN_L dominant (nominal)	1.5 V
Bus idle operation	VCAN_H = VCAN_L = +2.5 V

Table 17: CAN-Bus Level

5.4.3 Information for First-Time Users

CANopen is a Fieldbus system for industrial use. Its advantages lie in its application. In particular, the various types of process data transmission permit a host of different applications.

To make the system even easier and safer for first-time users to use, we recommend proceeding as outlined in the table below.

Work Phase	Question	Note
Planning	How many I/Os are required in total?	From this, you can derive whether you require one or more CANOpen networks for implementation.
Planning	How high is the system power requirement?	Important for the selection of a suitable system power supply unit.
Planning	How large is the entire scope of the system?	Important for selecting the CAN-Bus cable and baud rate.
Configuration	How are the NODE IDs of the modules to be assigned?	To avoid assignment errors, you should make a plan. Carefully label all addressed modules accordingly.
Mounting	Where will the modules be installed?	Depends on the module enclosure type. Either in a switch cabinet or terminal box. Place modules with IP 67 protection close to sensors and actuators to achieve greater efficiency.
Startup	How will the system configuration be executed?	The modules can be configured with a suitable software via the imported EDS file.
Startup	Have all CAN-Bus devices on the bus reported after Power ON?	When all CAN-Bus devices have reported, slave configuration can begin.
Startup	How can a simple I/O function test be performed?	Quick and straightforward, with special, easy-to-use setup tools such as the CANopen Master Simulator). Alternatively, the I/O test can also be performed via PLC software

Table 18: Planning and configuration procedure

5.4.4 Connection of CAN Bus Lines

5.4.4.1 General Line Routing

Cable routing is a very important criterion for interference-free operation of the equipment. When routing cables, be sure to observe the following:

1. Do not route bus cables parallel to high-voltage cables; where applicable, route in separate bundles, or cable troughs, or channels.
2. The PE cable connection must be star-shaped.
3. Prevent potential differences by connecting equipotential bonding conductors.
4. CAN-Bus cable shields must be attached to the connectors.
5. All analog signals should be carried by shielded cable.
6. Signal and power supply cables to the terminal block should be sufficiently long to prevent pull stresses on the terminals.

5.4.4.2 Avoiding Interference Voltage

The following points must be observed in order to reduce or prevent voltage interference when setting up a system:

1. Shielding devices and cables where stipulated (VDE 0113 and VDE 0829 etc.),
2. Suitable location of the devices and cables.
3. Take appropriate interference suppression measures for devices emitting interference (e.g. frequency transformers, valves, contactors etc.).
4. Make sure that device and shield grounding methods are massive and comprehensive.

5.4.4.3 Connecting the CAN-Bus

The selection of CAN-Bus cables and the respective data transfer rate takes place in three steps:

1. Determine the required cable core cross-section depending on the number of CAN-Bus devices and cable length.
2. Then read off the specific conductor resistance and/or core cross-section in the AWG.
3. Read off the permitted baud rate.

For these 3 steps, use the tables in Section 5.4.4.4!

In exceptionally difficult situations, it may not be possible to establish cable parameters and permissible data transfer rates with the procedure described. In such cases, please refer to the ISO 11898, CiA-DS102 and CiA-DR303-1 standards. The following sections are excerpts from these standards.

5.4.4.4 CAN-Bus Cable Description

The CiA-DS102 for bus connection and bus medium enables the realization of open CAN networks as a general industrial field bus. The CiA standard is based on high-speed bus interfacing according to ISO 11898; it also specifies a Sub-D connector and a surge impedance-terminated, two-wire lead cable with common return circuit as transfer medium. The maximum cable length is 1000 meters. The maximum length of spur lines at a baud rate of 1000 Kbit/s is 0.3 m. The bus line used must be twisted and shielded. Cable shielding is required because of the transmission technology. For spur lines, a cross-section of 0.25 mm² to 0.34 mm² is usually sufficient. Further CiA-specified cables and connectors are listed in DR303-1.

Drop lines may only have a maximum length of 0.3 m at a baud rate of 1000 Kbit/s.

The number of CAN-Bus devices must be taken into consideration when selecting the conductor cross-section. The table below lists the limits.

Number of CAN-Bus devices	Line Length [m]	Core Cross-section [mm²]	Cable Resistance [Ω]
32	200	0.25	<21
	360	0,50	
	550	0.75	
64	170	0.25	<18.5
	310	0,50	
	470	0.75	
100	150	0.25	16
	270	0,50	
	410	0.75	

Table 19: Cable cross-sections as a function of cable length and the number of bus devices

Repeaters must be used for more than 30 CAN-Bus participants.

Further selection criteria are the DC parameters listed in the table below.

Line Length [m]	Specific Cable Resistance [mΩ/m]	Core Cross-section [mm²]	Maximum Baud Rate [Kbit/s]
0 to 40	70	0.25 to 0.34 AWG23, AWG22	1000 at 30 m
40 to 300	< 60	0.34 to 0.6 AWG22, AWG20	500 at 100 m
300 to 600	< 40	0.5 to 0.6 AWG20	100 at 500 m
600 to 1000	< 26	0.75 to 0.8 AWG18	50 at 1000 m

Table 20: DC Cable Parameters

The parameters in Table 20: must be considered for networks compliant with ISO11898-2. In order to minimize voltage drop in the cable, a larger bus-terminating resistor than those specified in ISO11898-2 should be selected for long cable lengths. In the system configuration, the DC connector parameters must also be taken into consideration. For each connector, 5 mΩ to 20 mΩ must be added to the cable resistance.

The ground potential difference at CAN_GND terminals of all CAN-Bus devices should not exceed 2 V.

Plug connectors have a typical DC resistance of 5 m Ω to 20 mΩ.

In approximation, the following is valid for bus termination:

Terminate the CAN bus between CAN_H and CAN_L with 121 Ω.

The max. permitted line length as a factor of baud rate is listed in the table below.

Baud Rate [Kbit/s]	Line Length [m]	Nominal Bit Time [µs]
1000	30	1
800	50	1,25
500	100	2
250	250	4
125	350	8
100	500	10
50	1000	20
20	2500	50
10	5000	100

Table 21: Max. permissible cable length as a function of baud rate

Installation is greatly simplified through the use of preterminated lines. Wiring errors are avoided and setup is more rapidly successful.

➔ ***The product portfolio of Murrelektronik GmbH covers fieldbus cables, power cords, and sensor cables, as well as accessories, such as terminating resistors and T fittings. Freely terminatable connectors and cables are also available.***

Refer to our catalog or visit our inline shop at ***www.murrelektronik.com***.

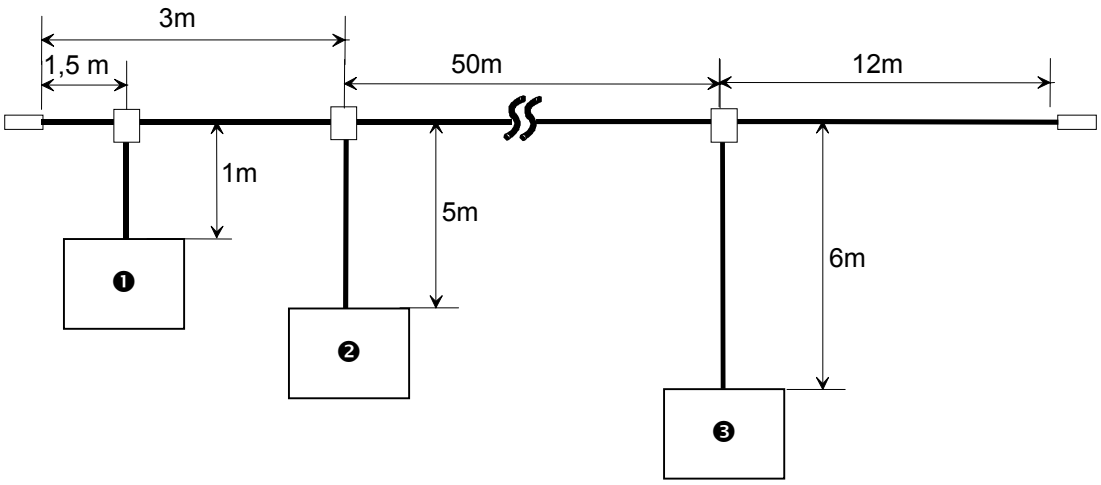
Also consider the specific signal delay time of the CAN bus line.

In the case of electrical two-wire cables, the signal run-time is 5 ns/m.

5.4.4.5 Maximum Bus Length and Position of Bus Terminating Resistors

If the distance from a branch in the main cable to its furthest removed module is greater than the distance to the next terminator, this spur line length (Drop B) is calculated in the total cable length.

A sample network is depicted in the table below.



❶ Node 1 (Drop A)

❷ Node 2 (Drop B)

❸ Node 3 (Drop C)

Fig. 16: Position of terminating resistors / maximum bus length

Drop A: does not appear in the max. cable length 1.5 m > 1 m

Drop B: is calculated into the max. cable length 3 m < 5 m

Drop C: does not appear in the max. cable length 12 m > 6 m

Maximum bus length: 5 m + 50 m + 12 m = 67 m

In the above example, the bus terminating resistors are installed at the end of Drop B and at the end of the
12 m cable.

Terminate the CAN bus between CAN_H and CAN_L with 121 Ω.

5.4.4.6 Connecting the CAN-Bus Cable

5.4.4.7 Cables

The CAN-Bus network requires cables that conform to ISO 11898 and DR 303-1 standards. We recommend the use of out preterminated CAB-Bus cables which are simple and reliable to install.

➔ ***Please refer to the chapter Accessories on page 88 or our Catalog or our Online Shop at*** *Fehler! Textmarke nicht definiert.*

5.4.4.8 Connecting the IMPACT20 CANopen

1. Connect function ground to FE terminal on housing.
2. Connect incoming bus cables to the bus terminal.

Every bus segment must be installed with a terminating resistor at start and end.

5.4.4.9 Pin assignment of fieldbus connection

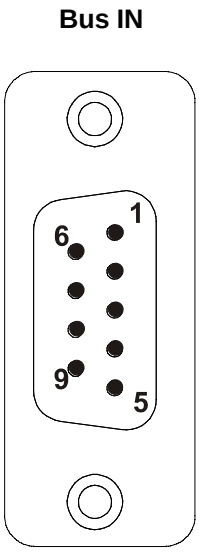


Fig. 17: Bus terminal

Pin 1	n.c.
Pin 2	CAN_L
Pin 3	CAN_GND
Pin 4	n.c.
Pin 5	CAN_SHLD
Pin 6	GND
Pin 7	CAN_H
Pin 8	n.c.
Pin 9	n.c.
Thread	

Table 22: Bus connector pin assignment

5.5 Starting Up the Fieldbus

5.5.1 Terminating DeviceNet Bus Segments

Each segment must be terminated with a terminating resistor of 120 Ω at the start and end.

5.5.2 Mapping I/O Data

After the initialization phase of all CAN-Bus devices, they have reported to the CAN-Bus with one Boot-Up Message each.

Based on the configuration, the master creates a complete periphery map of the slaves in the PLC. The user can assign the read-in I/O bytes to logical addresses in the controller.

This shows the schematic diagram of an CANopen network:

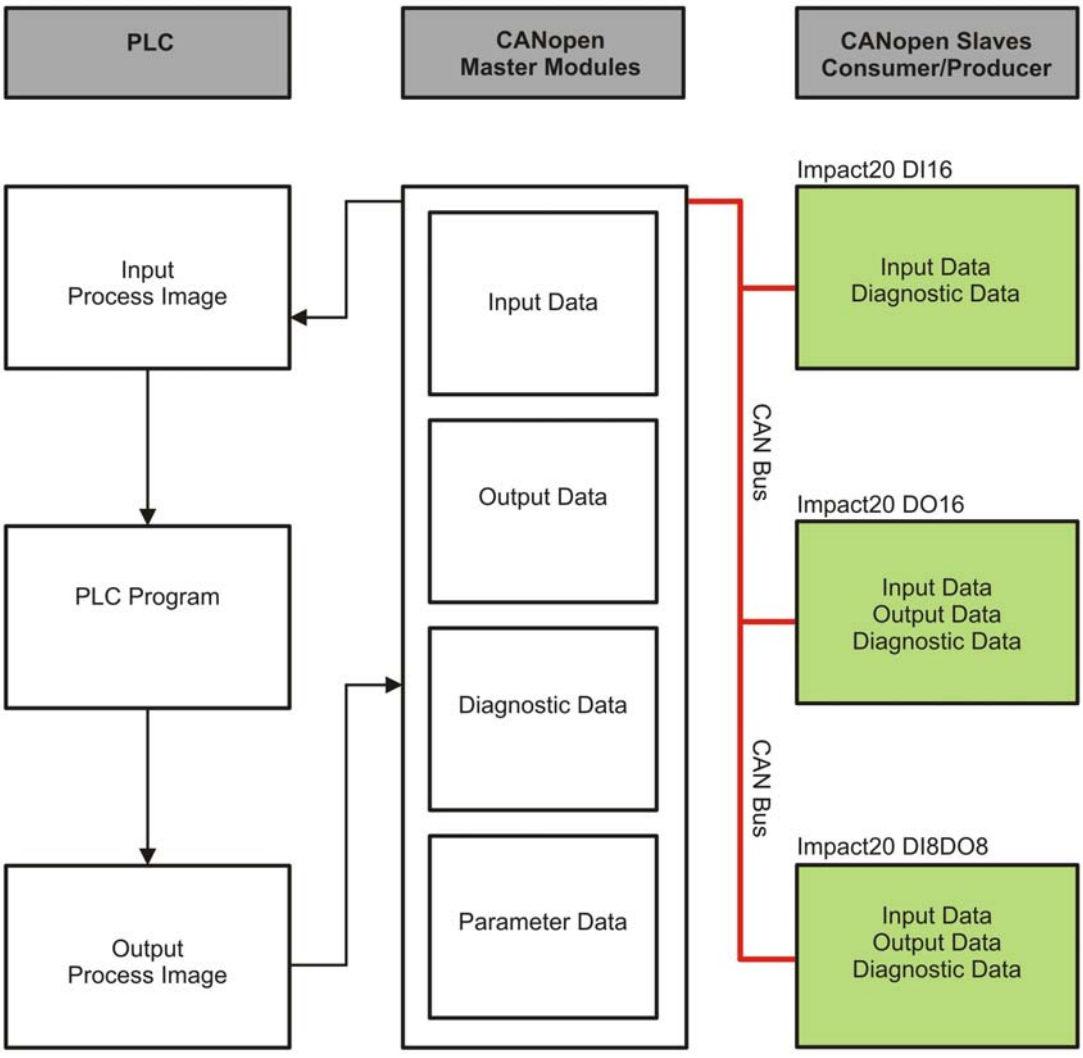


Fig. 18: Data transfer: PLC with interface module (CANopen Master) and CANopen slaves

5.5.3 EDS Files

The EDS file is created explicitly for the device type (I/O). Consequently, each module of the IMPACT20 series has a separate EDS file with the extension (*.eds) plus an icon in the form of a bitmap with the extension (*.ico) assigned to it.

The EDS file contains a lot of information concerning the module e.g.:

device type, manufacturer, vendor ID, article number, software version, hardware version, etc.

EDS files are module-specific. Only Murrelektronik technical personnel are allowed to perform application-specific modifications.

EDS files are assigned as shown in the table below:

Module type	Name of EDS file	Name of icon
IMPACT20 C DI16	IMPACT20C_DI16_56904_E_1_0.eds	IMPACT20C_DI16_56904_E_1_0.bmp
IMPACT20 C DI8 DO8	IMPACT20C_DI8DO8_56905_E_1_0.eds	IMPACT20C_DI8DO8_56905_E_1_0.bmp
IMPACT20 C DO16	IMPACT20C_DO16_56906_E_1_0.eds	IMPACT20C_DO16_56906_E_1_0.bmp

Table 23: EDS files

The last character E or D in the EDS file name stands for the EDS file language e.g. D= Deutsch, E= English.

It is of no consequence to the function of the composite network what file is embedded in the startup tool. It only enhances the legibility of the variables.

The latest EDS files are retrievable over the web from: http://www.murrelektronik.com. Navigate to the download section under configuration files.

5.5.4 Addressing

Fig. 19: Assignment of rotary switches for addresses and baud rate

DR	Rotary switch to set the baud rates
NA x 10	Node ID switch ×10
NA x 1	Node ID switch ×1
Permitted addresses	1 to 99

There are two switches for setting the Node ID: x10 (decades) and x1 (single digits). Addresses 1 to 99 are permitted. The Node ID is only taken over when the module power supply is applied by the IMPACT20 module. As a result, a power reset must always be made after the Node ID is changed.

Make absolutely sure that the set Node ID is unique in the CANopen network. Address 0 is not allowed.

Rotary switch to set baud rate (DR)

The baud rate is set with a "DR" rotary switch. Bit timing corresponds to the requirements of the CiA. The following data rates can be set:

Switch Position	Baud rate [Kbit/s]
0	Automatic recognition
1	10
2	20
3	50
4	100
5	125
6	250
7	500
8	800
9	1000

Table 24: Setting the Baud Rate

Messages (e.g. SYNC telegrams) must be transferred on the CAN-Bus for automatic baud rate recognition (switch position 0) to take place. The IMPACT20 module tries to recognize the baud rate used and accepts this as a default. While the IMPACT20 module is searching for the baud rate, the RUN and Err LEDs flash at a rate of 10 Hz. When the baud rate is finally detected, the IMPACT20 module reverts to "Pre-Operational" state and can be used as a CANopen module. The baud rate is searched again every time the module is started up. The baud rate detected in not saved. TO change the data rate, restart the IMPACT20 module. An NMT reset (reset node or reset communication) is not sufficient to change the baud rate.

A search for the baud rate is only carried out when the module power supply UI is applied. The baud rate setting is accepted only when the power supply is applied. A power reset is required to change the baud rate. An NMT reset (reset node or reset communication) is not sufficient to change the baud rate.

5.5.5 Object Directory "Communication Profile“ CanOpen Modules

5.5.5.1 Art. No. 56904 IMPACT20 C DI16

Index	Name	Access	Standard value
1000H	Device Type	read only	00010191H
1001H	Error Register	read only	0
1002H	Manufacturer Status Register	read only	0
1003H	Predefined Error Field	read only	*
1005H	COB-ID SYNC Message	read only	80H
1006H	Communication Cycle Period	read only	0
1008H	Manufacturer Device Name	read only	IMPACT20 C DI16
100AH	Manufacturer Software Version	read only	SW1.00
100CH	Guard time	read only	0
100DH	Life time factor	read only	0
1010H	Store parameters	read only	*
1011H	Restore default parameters	read only	*
1014H	COB-ID emergency	read only	80H + Node ID
1016H	Consumer heartbeat time	read only	*
1017H	Producer heartbeat time	read only	*
1018H	Identity Object	read only	*
1200H	Server SDO parameter	read only	*
1400H	Receive PDO Communication Parameter	read only	*
1405H	Receive PDO Communication Parameter	read only	*
1600H	Receive PDO Mapping Parameter	read only	*
1605H	Receive PDO Mapping Parameter	read only	*
1800H	Transmit PDO Communication Parameter	read only	*
1805H	Transmit PDO Communication Parameter	read only	*
1A00H	Transmit PDO Mapping Parameter	read only	*
1A05H	Transmit PDO Mapping Parameter	read only	*

(*) - If no entry is configured under default, the object index has other subindices whose contents are described in detail in the following sections.

Table 25: Communication Profile of CANopen Modules Art. No. 56904 IMPACT20 C DI16

Note: The correct defaults are contained in the EDS.

5.5.5.2 Art. No. 56905 IMPACT20 C DI8 DO8

Index	Name	Access	Standard value
1000H	Device Type	read only	0x30191H
1001H	Error Register	read only	0
1002H	Manufacturer Status Register	read only	0
1003H	Predefined Error Field	read only	*
1005H	COB-ID SYNC Message	read only	80H
1006H	Communication Cycle Period	read only	0
1008H	Manufacturer Device Name	read only	IMPACT20 C DI8 DO8
100AH	Manufacturer Software Version	read only	SW1.00
100CH	Guard time	read only	0
100DH	Life time factor	read only	0
1010H	Store parameters	read only	*
1011H	Restore default parameters	read only	*
1014H	COB-ID emergency	read only	80H + Node ID
1016H	Consumer heartbeat time	read only	*
1017H	Producer heartbeat time	read only	*
1018H	Identity Object	read only	*
1200H	Server SDO parameter	read only	*
1400H	Receive PDO Communication Parameter	read only	*
1405H	Receive PDO Communication Parameter	read only	*
1600H	Receive PDO Mapping Parameter	read only	*
1605H	Receive PDO Mapping Parameter	read only	*
1800H	Transmit PDO Communication Parameter	read only	*
1805H	Transmit PDO Communication Parameter	read only	*
1A00H	Transmit PDO Mapping Parameter	read only	*
1A05H	Transmit PDO Mapping Parameter	read only	*

(*) - If no entry is configured under default, the object index has other subindices whose contents are described in detail in the following sections.

Table 26: Communication Profile of CANopen Modules Art. No. 56905 IMPACT20 C DI8 DO8

5.5.5.3 Art. No. 56906 IMPACT20 C DO16

Index	Name	Access	Standard value
1000H	Device Type	read only	00020191H
1001H	Error Register	read only	0
1002H	Manufacturer Status Register	read only	0
1003H	Predefined Error Field	read only	*
1005H	COB-ID SYNC Message	read only	80H
1006H	Communication Cycle Period	read only	0
1008H	Manufacturer Device Name	read only	IMPACT20 C DO16
100AH	Manufacturer Software Version	read only	SW1.00
100CH	Guard time	read only	0
100DH	Life time factor	read only	0
1010H	Store parameters	read only	*
1011H	Restore default parameters	read only	*
1014H	COB-ID emergency	read only	80H + Node ID
1016H	Consumer heartbeat time	read only	*
1017H	Producer heartbeat time	read only	*
1018H	Identity Object	read only	*
1200H	Server SDO parameter	read only	*
1400H	Receive PDO Communication Parameter	read only	*
1405H	Receive PDO Communication Parameter	read only	*
1600H	Receive PDO Mapping Parameter	read only	*
1605H	Receive PDO Mapping Parameter	read only	*
1800H	Transmit PDO Communication Parameter	read only	*
1805H	Transmit PDO Communication Parameter	read only	*
1A00H	Transmit PDO Mapping Parameter	read only	*
1A05H	Transmit PDO Mapping Parameter	read only	*

(*) - If no entry is configured under default, the object index has other subindices whose contents are described in detail in the following sections.

Table 27: Communication Profile of CANopen Modules Art. No. 56906 IMPACT20 C DO16

5.5.6 Object Description of Communication Profile

5.5.6.1 Object 1000H: Device Type (DT)

This object describes the device type and its functionality. The device description comprises two 16-bit fields. One field contains the Device Profile Number and the other the Additional Information.

Bit	
MSW	**LSW**
Additional Information	Device Profile Number
000XH	0191H

Table 28: Structure of Device Type, Object 1000H

Device Profile Number: 401D = 191H

The device profile number 401D equals the number of the CIA standard for I/O devices.

Additional Information: 1st bit set: Digital inputs available

2nd bit set: Digital outputs available

5.5.6.2 Object 1001H: Error Register (ER)

The device can display internal errors with the 8-bit ER field. If a device error occurs, the corresponding bit is set in the ER. The following errors can be displayed:

Bit	Meaning	Comments
0	Generic error	
1	Current	
2	Voltage	
3	Temperature	not supported
4	Communication error	
5	Reserved	
6	Reserved	
7	Manufacturer-specific	not supported

Table 29: Error register structure, Object 1001H

5.5.6.3 Object 1002H: Manufacturer Status Register

Diagnostic data are recorded in a 32-bit field. The **lower 8-Bit** of the "Manufacturer Status Register" is contained in the EMCY message and is transmitted at the same time when the diagnostic event occurs. The following table indicates the assignment of the bytes.

Bit	Meaning	Comments
0	Module power supply undervoltage	
1	Reserved	
2	Actuator undervoltage	
3	Reserved	
4	Sensor short-circuit	
5	Actuator short-circuit[2]	
6 to 31	Reserved	

Table 30: Description of object 1002H: Manufacturer Status Register

2

[2] only if outputs are present

5.5.6.4 Object 1003H: Predefined Error Field (PEF)

"Additional Information" is entered in this 32-bit "error register“ when an error occurs in the LSW of the "Error Code" and in the

MSW. The last error occurring is in Subindex 1.

Existing errors shift to Subindex 2, the error from Subindex 2 shifts to Subindex

3, etc.

Errors can only be deleted completely by writing data 0x00 in object 1003,00.

See **section 5.5.9.2** for a definition of the error codes.

Error correction does not delete the error Entry in the PEF.

An emergency telegram (EMCY telegram) is always transmitted when an error occurs.

When an error is rectified, an EMCY telegram containing NO ERROR is sent (Error Code

0x0000).

Bit	
MSB	**LSB**
Additional Information	Error Code
0000H	0000H

Table 31: Structure of the predefined error field

Index	Subindex	Additional Information	Error Code	Description
1003H	0			Number of errors (8 bit)
	1			Error (32 bit)
	…			
	Max. 10			

Table 32: Structure of the predefined error field

5.5.6.5 Object 1005H: COB-ID SYNC Message

The communication parameters for the synchronization telegram are stored in this 32-bit field.

Bit Number	Value	Meaning / Remarks
31 (MSB)	0	Not relevant
30	0	Device creates no sync-object
29	0	11-Bit ID (CAN 2.0A)
28 – 11	0	Not relevant
10 – 0	X	Identifier

Table 33: Description of the SYNC COB-ID entries

5.5.6.6 Object 1006H: Communication Cycle Period

This object describes the time interval between two SYNC signals in µs. The smallest time unit is 1 ms. This must be kept in mind when selecting SYNC intervals. The entry is made in a 32-bit field. If unused, the field content is zero. If a value between 10 000 and 10 000 000 is listed, the node must receive a SYNC signal within this stated time or the node assumes pre-operational state. The time differential is max. 1% of the set value. Time monitoring begins with the receipt of the first SYNC signal.

Some of the values are entered in the table below:

Object 1006H	Decimal	Hexadecimal	SYNC interval in ms
Default value	0	0H	-
Minimum value	10 000	0000 2710H	10
	25 000	0000 61A8H	25
	250 000	0003 D090H	250
	1 000 000	000F 4240H	1 000
	5 000 000	004C 4B40H	5 000
Maximum value	10 000 000	0098 9680H	10 000

Table 34: Description of Object 1006H: Communication Cycle Period

5.5.6.7 Object 1008H: Manufacturer Device Name (MDN)

With the MDN, device information can be stored in the form of an ASCII string.
The device name is "IMPACT20 C DI16" or "IMPACT20 C DI8/DO8" or "IMPACT20 C DO16".

5.5.6.8 Object 100AH: Manufacturer Software Version (MSV)

The software version is entered as an ASCII string in the MSV. The signal "SWx.xx" is transferred when this object is requested. ”SW1 00“ stands for software version 1.00.

5.5.6.9 Object 100CH: Guard Time and Object 100DH: Life Time Factor

Description of Node and Life-Guarding Principle

Object 100CH contains the Guard Time in milliseconds. Object 100DH contains the Life Time Factor.

Life Time is calculated as follows:

Life Time = Guard Time x Life Time Factor

If one of the two parameters is "0" (default), there is no master monitoring (no life guarding).

In order to activate time monitoring, set at least value 1 in Object 100DH and enter a time in ms in Object 100CH. To guarantee reliable operation, enter a life time factor of at least 2, otherwise the node will switch to "pre-operational" state without the existence of an error in the event of a delay (e.g. caused by high-priority messages or internal processing of the Node Guarding Master).

In the guarding process, the Master Remote Frame (remote transmit request, message request telegrams) transmits to the guarding identifier of the monitored slaves. The slaves respond with the guarding message. The message contains the slave status code and a toggle bit which must change after every message. If the status or toggle bit fails to match the status expected by the NMT master, or if there is no response, the master assumes there is a slave error.

If the master requests guarding messages in a strict cycle, the slave may detect the failure of the master. In this case, the slave receives no message request from the master within the set "life time" (guarding error), and assumes that the master has failed (watchdog function). Then the slave sets its outputs to error state and reverts to pre-operational state. These two monitoring mechanisms are of special importance in CANopen since the modules do not report in event-controlled mode at regular intervals.

The master remote request also generates a reply without entries in the Guard Time or Life Time Factor objects. Time monitoring is only activated if values greater than 0 are entered in the two objects. Typical Guard Time values range from 250 ms to 2 seconds.

5.5.6.10 Object 1010H: Save Parameters

Using this object, module parameters can be saved in a nonvolatile memory (flash) and reloaded automatically from there after a voltage reset.

Subindex	Default Value	Description
0	4	Largest subindex supported
1		Save all parameters
2		Save communication parameters (1000H–1FFFH)
3		Save application parameters (6000H–9FFFH)
4		Save application parameters in manufacturer-specific object area (2000H–5FFFH)

Table 35: Save Parameters

To save the parameters, "save" (6576 6173) must be written in the related subindex.

Please remember that no outputs are set for "Save all parameters" (Subindex 1) or "Save application parameters" (Subindex 3). Saving is not permitted in this state and the device replies with an SDO Transfer Error Message: 0800 0022h.

When the correct signature is received, the device saves the parameters and then confirms this process

by sending an SDO transmission (initiate download response). If the save operation fails,

the device replies with an SDO Transfer Error Message: 06 0000h).

Signature	MSB			LSB
ISO 8859 ("ASCII")	E	v	a	s
Hex	65	76	61	73

Table 36: SDO

If an incorrect signature was written, the device does not save the parameters and

replies with an SDO Transfer Error Message: 0800 002xh).

In the event of a read access to a subindex, the device return information via the supported

memory function (32-bit) as follows:

Bits	Value	Meaning
31 to 2	0	Reserved
1	0 1	The device does not save the parameters automatically. The device saves the parameters automatically.
0	0 1	The device does not save the parameters on command. The device saves the parameters on command.

Table 37: Read access to a subindex

5.5.6.11 Object 1011H: Restore Default Parameters

CANopen uses this object to restore default parameters stored in the firmware.

Subindex	Default Value	Description
0	4	Largest subindex supported
1		Restore all parameters
2		Restore communication parameters (1000H–1FFFH)
3		Restore application parameters (6000H–9FFFH)
4		Restore application parameters in manufacturer-specific object area (2000H–5FFFH)

Table 38: Restore default parameters

To save the default parameters, "load" (6461 6F6C) must be written in the related subindex.

When the correct signature is received, the device restores the parameters and confirms this process by transmitting an SDO (initiate download response). If the restore operation fails, the device replies with an SDO Transfer Error Message: 0606 0000h

Signature	MSB			LSB
ISO 8859 ("ASCII")	d	a	o	l
Hex	64	61	6F	6C

Table 39: SDO

If an incorrect signature was written, the device does not restore the parameters and responds by reporting an error in an SDO transmission: 0800 002xh).

The default values are taken over after a device reset (NMT Reset Node for Subindex 1h – 4h, NMT Reset Communication for Subindex 2h), or after a power reset.

When a read access to a subindex occurs, the device sends back information via the supported restore function (32-bit) as follows:

Bits	Value	Meaning
31 to 1	0	Reserved
0	0 1	The device does not restore the default parameters The device restores the default parameters

Table 40: Read access to a subindex

5.5.6.12 Object 1014H: COB-ID Emergency Message

The value entered in this object is used as a COB-ID for emergency node messages. When changing the COB-ID, no value may be used that is being used in the node or in the network as a COB-ID for another message. The structure of the EMCY-COB-ID is shown in the table below.

	Bit				
	MSB				**LSB**
	31	30	29	28 - 11	10 - 0
CAN 2.0A:	0	0	0	000000000000000000	11-bit identifier

Table 41: Structure of EMCY COB-ID entry, object 1014H

5.5.6.13 Object 1016H: Consumer Heartbeat Time

The Consumer Heartbeat Time defines the expected heartbeat cycle time and should be configured higher than the corresponding Producer Heartbeat Time of the device that sends the heartbeat. Monitoring starts after the reception of the first heartbeat. If the Consumer Heartbeat Time is zero, it is not sent. The time entered is multiplied by 1 ms.

Subindex	PDO Mapping	Access	Default Value	Description
0	No	Ro	01h	
1	No	Rw	0	Consumer heartbeat time

Table 42: Heartbeat

Structure of Consumer Heartbeat Time entry (32-bit).

	MSB		LSB
Bits	31 to 24	23 to 16	15 to 0
Value	Reserved	Node ID	Heartbeat Timer
Coded as	-	Unsigned8	Unsigned16

Table 43: Consumer Heartbeat Time entry

5.5.6.14 Object 1017H: Producer Heartbeat Time

The Producer Heartbeat Time defines the cycle time of the heartbeat transmitted. If the entry is 0, the Producer Heartbeat Time is not used and the node sends no heartbeat. The time has to be a multiple of 1 ms.

Subindex	PDO Mapping	Access	Default Value	Description
0	No	Rw	00H	

Table 44: Producer Heartbeat Time

The heartbeat is generated in the bus module periodically (the period is the Heartbeat Producer Time): It is sent without receiving an RTR (Remote Transmission Request).

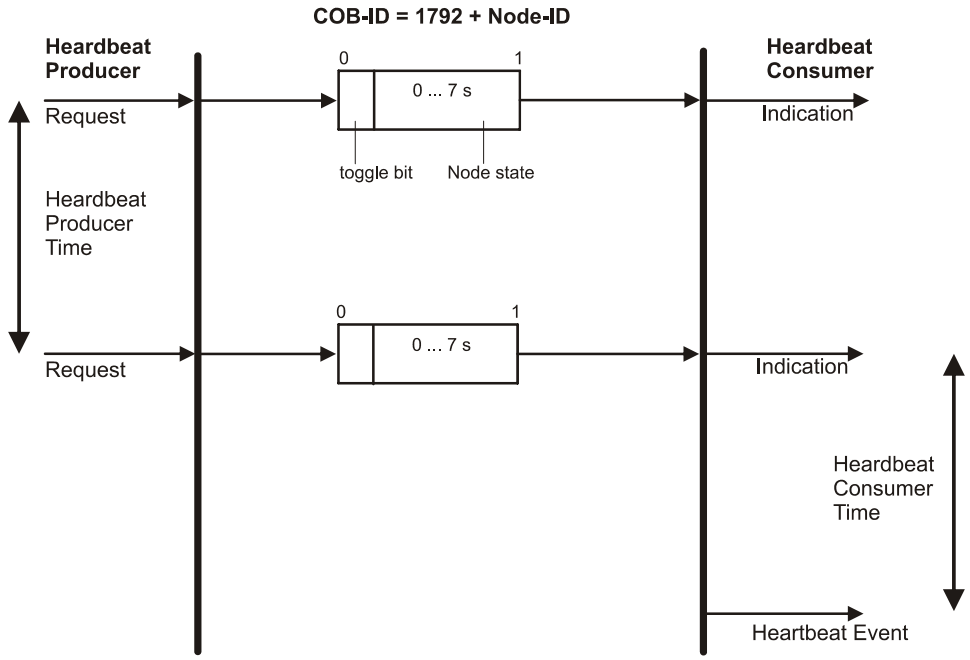


Fig. 20: Definition of the Bootup Message

S: Status of the Heartbeat Producer

0: BOOTUP

4: STOPPED

5: Operational

127: Pre-Operational

When the Heartbeat Producer Time is configured on a device, the Heartbeat protocol starts immediately. When a device starts with a Heartbeat Producer Time value that is unequal to zero, the Heartbeat protocol starts form the initialization status after Pre-Operational. In this case, the bootup message is the first heartbeat message. The MSB value is always zero.

It is not permitted to use the heartbeat and node guarding simultaneously. When the Heartbeat Producer Time input is unequal to zero, the Heartbeat protocol is used.

5.5.6.15 Object 1018H: Identity Object

Object 1018H contains general information about the device. The Vendor ID (manufacturer identification number issued by the CiA) is entered in Subindex 1; the Article Number of the IMPACT20 is contained in Subindex 2; and the revision number that is combined from the main revision number and the secondary revision number is contained in Subindex 3. If the CANopen functionality is expanded, the main revision number is increased. The secondary revision number is incremented in the event of a software change that changes the device functionality, but has no impact on CANopen functionality.

5.5.6.15.1 Identity Object for Art. No. 56904 IMPACT20 C DI16

Index	Subindex	Description	Default value
1018H	0	Number of entries	3
	1	Vendor ID (32-bit)	4F
	2	Product Code (32 bit)	DE48H
	3	Revision Number (32 bit)	00010001H

Table 45: Identity Object

5.5.6.15.2 Identity Object for Art. No. 56905 IMPACT20 C DI8 DO8

Index	Subindex	Description	Default value
1018H	0	Number of entries	3
	1	Vendor ID (32-bit)	4F
	2	Product Code (32 bit)	DE49H
	3	Revision Number (32 bit)	00010001H

Table 46: Identity Object

5.5.6.15.3 Identity Object for Art. No. 56906 IMPACT20 C DO16

Index	Subindex	Description	Default value
1018H	0	Number of entries	3
	1	Vendor ID (32-bit)	4F
	2	Product Code (32 bit)	DE4AH
	3	Revision Number (32 bit)	00010001H

Table 47: Identity Object

5.5.6.16 Object 1200H: Server SDO Parameter

This object contains the COB-ID for the communication between client and server in Subindex 1 and the COB-ID in the opposite direction in Subindex 2.

Index	Subindex	Description	Default value
1200h	0	Number of entries	2
	1	Client to Server	600H + Node ID.
	2	Server to Client	580H + Node ID

Table 48: Server SDO Parameters

5.5.6.17 Objects 1400H and 1405H: Receive PDO Communication Parameters

Communication parameters for Receive PDOs are stored in these objects. The parameters are:

- PDO COB-ID in **Subindex 1**
- PDO transmission mode (asynchronous, cyclic synchronous and acyclic synchronous**) in Subindex 2**.

Description of Subindex 1 (32-bit):

Bit Number	Value	Meaning
31 (MSB)	0	PDO valid
	1	PDO not valid
30	0	RTR allowed
	1	RTR not allowed
29	0	11-Bit ID (CAN 2.0A)
28 to 11	0	0 since Bit 29 = 0
10 to 0	-	Bit 10 - 0 of the identifier

Table 49: Receive PDO communication parameters

Description of Subindex 2 (8-bit):

Trans-mission Code	PDO transmission mode					Comments
	Cyclical	Acyclic	Synchro-nous	Asynchro-nous	RTR only	
0		X	X			Update data after the Sync mes-sage following the receipt of PDO
1 to 240*	X		X			Update data x Sync- message fol-lowing the receipt of PDO
241 to 251	reserved					
252	not supported					
253	not supported					
254				X		Output data taken over on receipt of PDO such as 255
255				X		Update data taken over on receipt of PDO

(*)(indicates the number of SYNC objects that are necessary to transfer the PDOs

Table 50: Description of Subindex 2

5.5.6.17.1 Receive PDO for Art. No. 56904 IMPACT20 C DI16

→ does not support receive PDO, therefore there are no communication parameters

5.5.6.17.2 Receive PDO for Art. No. 56905 IMPACT20 C DI8 DO8

→ supports 1 receive PDO

Index	Subindex	Description	Default
1400h	0	Number of entries of the 1st Receive PDO	2
	1	COB-ID of PDO (32-bit)	200H + Node ID
	2	Transmission mode (8-bit)	FFH

Table 51: Receive PDO

5.5.6.17.3 Receive PDO for Art. No. 56906 IMPACT20 C DO16

→ supports 2 receive PDOs the second PDO is deactivated

Index	Subindex	Description	Default
1400h	0	Number of entries of the 1st Receive PDO	2
	1	COB-ID of PDO (32-bit)	200H + Node ID
	2	Transmission mode (8-bit)	FFH

Table 52: Receive PDO

5.5.6.18 Objects 1600H and 1605H: Receive PDO Mapping Parameters

This Object assigns the received data to the inputs in the object folder and enters the parameters in a subindex.

The value is entered in a 32-bit field. This field is divided into one 16-bit and two 8-bit areas. The index of the assigned object is found in the 16-bit field and the first 8-bit field is in the subindex. The second 8-bit field states the length of the assigned entry. The table below depicts the relationship as an example.

MSB		LSB
Index (16-bit)	Subindex (8-bit)	Object length (8-bit)
6200h	01h	08h

Table 53: Receive PDO mapping parameters

5.5.6.18.1 Art. No. 56904 IMPACT20 C DI16

→ does not receive PDO

5.5.6.18.2 Art. No. 56905 IMPACT20 C DI8 DO8

Index	Subindex	Description	Default value
1600H	0	Number of assigned objects, 1st receive PDO	1
	1	1st assigned object, digital outputs Channels X2 (20 to 23) and X3 (30 to 33)	6200 01 08h

Table 54: Receive PDO mapping parameters

5.5.6.18.3 Art. No. 56906 IMPACT20 C DO16

Index	Subindex	Description	Default value
1600H	0	Number of assigned objects, 1st receive PDO	1
	1	1st assigned object, digital outputs Channels X0 (00 to 03) and X1 (10 to 13)	6200 01 08h
	2	2nd assigned object, digital outputs Channels X2 (20 to 23) and X3 (30 to 33)	6200 02 08h

Table 55: Receive PDO Mapping Parameters

5.5.6.19 Objects 1800H and 1805H: Transmit PDO Communication Parameters

Communication parameters for Transmit PDOs are stored in these objects. The parameters are:

- COB-ID of the PDO
- PDO transmission mode (asynchronous, cyclic synchronous, and acyclic synchronous).

Every parameter is entered in a subindex.

In the presetting, the COB-ID of the PDO is deactivated with Index 1805H, i.e. the PDO is not sent.

Description of Subindex 1 (32-bit):

Bit Number	Value	Meaning
31 (MSB)	0	PDO valid
	1	PDO not valid
30	0	RTR allowed
	1	RTR not allowed
29	0	11-Bit ID (CAN 2.0A)
28 to 11	0	0 since Bit 29 = 0
10 to 0	-	Bit 10 - 0 of the identifier

Table 56: Description of Subindex 1

Description of Subindex 2 (8-bit):

Trans-mission Code	PDO transmission mode					Comments
	Cyclical	Acyclic	Synchro-nous	Asynchro-nous	RTR only	
0		X	X			Update data after the Sync mes-sage following the receipt of PDO
1 to 240*	X		X			Update data x Sync- message following the receipt of PDO
241 to 251	reserved					
252	not supported					
253	not supported					
254				X		Output data taken over on receipt of PDO such as 255
255				X		Update data taken over on receipt of PDO

(*)(indicates the number of SYNC objects that are necessary to transfer the PDOs

Table 57: Description of Subindex 2

5.5.6.19.1 Art. No. 56904 IMPACT20 C DI16

Index	Subindex	Description	Default value
1800H	0	Number of entries of 1st transmission PDO	5
	1	COB-ID of PDO (32-bit)	180H + Node ID.
	2	Transmission mode	FFh
	3	Inhibit time, or an	0x00
	5	Event timer.	0x00
1805H	0	Number of entries of 2nd Transmit PDO	5
	1	COB-ID of PDO (32-bit)	80000280H + Node ID
	2	Transmission mode	FFh
	3	Inhibit time, or an	0x00
	5	Event timer.	0x00

Table 58: Transmit PDO Communication Parameters

5.5.6.19.2 Art. No. Art. No. 56905 IMPACT20 C DI8 DO8

Index	Subindex	Description	Default value
1800H	0	Number of entries of 1st transmission PDO	5
	1	COB-ID of PDO (32-bit)	180H + Node ID.
	2	Transmission mode	FFh
	3	Inhibit time, or an	0x00
	5	Event timer.	0x00
1805H	0	Number of entries of 2nd Transmit PDO	5
	1	COB-ID of PDO (32-bit)	80000280H + Node ID
	2	Transmission mode	FFh
	3	Inhibit time, or an	0x00
	5	Event timer.	0x00

Table 59: Transmit PDO Communication Parameters

5.5.6.19.3 Art. No. 56906 IMPACT20 C DO16

Index	Subindex	Description	Default value
1805H	0	Number of entries of 1st transmission PDO	5
	1	COB-ID of PDO (32-bit)	80000280H + Node ID
	2	Transmission mode	FFh
	3	Inhibit time, or an	0x00
	5	Event timer.	0x00

Table 60: Transmit PDO Communication Parameters

5.5.6.20 Objects 1A00H and 1A05H: Transmit PDO Mapping Parameters

5.5.6.20.1 Art. No. 56904 IMPACT20 C DI16

Index	Subindex	Description	Default value
1A00H	0	Number of assigned objects, 1st Transmit PDO	2
	1	1st assigned object, digital inputs Channels X0 (00 to 03) and X1 (10 to 13)	6000 01 08H
	2	2nd assigned object, digital inputs Channels X2 (20 to 23) and X3 (30 to 33)	6000 02 08H
1A05H	0	Number of assigned objects, 2nd Transmit PDO	2
	1	1st assigned object, group diagnostic	3000 01 08H
	2	Reserved (0x00)	3000 02 08H

Table 61: Transmit PDO mapping parameters

5.5.6.20.2 Art. No. 56905 IMPACT20 C DI8 DO8

Index	Subindex	Description	Default value
1A00H	0	Number of assigned objects, 1st Transmit PDO	1
	1	1st assigned object, digital inputs Channels X0 (00 to 03) and X1 (10 to 13)	6000 01 08H
1A05H	0	Number of assigned objects, 2nd Transmit PDO	4
	1	1st assigned object, group diagnostic	3000 01 08H
	2	Reserved (0x00)	3000 02 08H
	3	Reserved (0x00)	3000 03 08H
	4	3rd assigned object, actuator short-circuit to GND Channels X2 (20 to 23) and X3 (30 to 33)	3000 04 08H

Table 62: Transmit PDO mapping parameters

5.5.6.20.3 Art. No. 56906 IMPACT20 C DO16

Index	Subindex	Description	Default value
1A05H	0	Number of assigned objects, 1st Transmit PDO	4
	1	1st assigned object, group diagnostic	3000 01 08H
	2	Reserved (0x00)	3000 02 08H
	3	2nd assigned object, actuator short-circuit to GND Channels X0 (00 to 03) and X1 (10 to 13)	3000 03 08H
	4	3rd assigned object, actuator short-circuit to GND Channels X2 (20 to 23) and X3 (30 to 33)	3000 04 08H

Table 63: Transmit PDO mapping parameters

5.5.7 Manufacturer-Specific Device Profile of CanOpen Modules

5.5.7.1 Object 6000H: Read Input 8-Bit

Reading of an input value with 8 inputs to be stored in one byte. Addresses are generated using index and subindex, whereby the subindex 0 contains the number of entries. The table below shows the assignment of subindices to inputs.

Subindex	Bit No.	Input Channel	Description
1 (Channels 00 to 03 and 10 to 13)	0	00	Status 1 if input 1
	1	01	
	2	02	
	3	03	
	4	10	
	5	11	
	6	12	
	7	13	
2 (Channels 20 to 23 and 30 to 33)	0	20	Status 1 if input 1
	1	21	
	2	22	
	3	23	
	4	30	
	5	31	
	6	32	
	7	33	

Table 64: Read Input 8-bit

5.5.7.2 Object 6200H: Write Output 8-Bit

The output values for outputs can only be written byte-wise. Addresses are generated using index and subindex, whereby subindex 0 contains the number of entries. The table below shows the assignment to outputs.

Subindex	Bit No.	Output Channel	Default value	Description
1 (Channels 00 to 03 and 10 to 13)	0	00	0	Output 1 if status 1
	1	01	0	
	2	02	0	
	3	03	0	
	4	10	0	
	5	11	0	
	6	12	0	
	7	13	0	
2 (Channels 20 to 23 and 30 to 33)	0	20	0	Output 1 if status 1
	1	21	0	
	2	22	0	
	3	23	0	
	4	30	0	
	5	31	0	
	6	32	0	
	7	33	0	

Table 65: Write Output 8-Bit

5.5.7.3 Object 3000H: Manufacturer-Specific Diagnostic Bytes

The function of this object is to request the diagnostic of each channel.

Subindex	Description	Default value
0	Number of entries	05H
1	Group diagnostics (manufacturer status register, lower 8 bit) →all modules	00H
2	Reserved (0x00)	00H
3	Actuator short-circuit to GND (channels 00 to 03 and 10 to 13) (channel diagnostic) → only modules with outputs	00H
4	Actuator short-circuit to GND (channels 20 to 23 and 30 to 33) (channel diagnostic) → only modules with outputs	00H

Table 66: Manufacturer-specific diagnostic bytes

5.5.8 Function of Bus Status LEDs

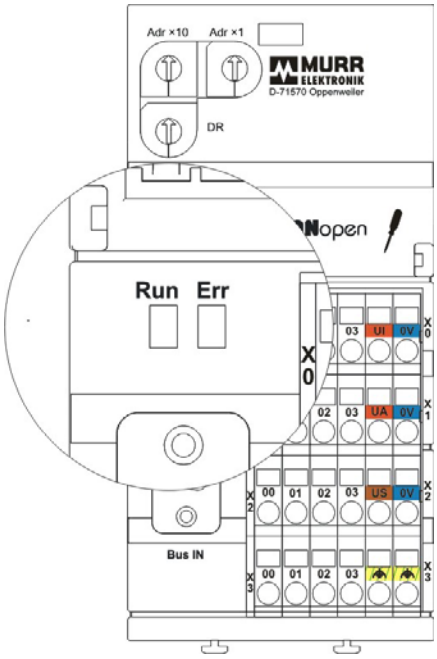


Fig. 21: CANopen module: Bus LEDs

Name	LED	Status	Description
RUN (green)	Flickering	AutoBaud	Auto Baud rate detection in progress
	Single flash	STOPPED	Device in STOPPED mode
	Blinking	Pre-Operational	Device in "Pre-Operational" mode
	On	Operational	Device in "Operational" mode
ERROR (red)	off	no error	Device operating normally (Device OK)
	Single flash	Warning limit reached	At least one of the error counters of the CAN controller has reached or exceeded the warning level (too many error frames)
	Flickering	AutoBaud	Auto Baud rate detection in progress
	Double flash	Error Control Event	A guarding error or a heartbeat was detected.
	Triple flash	Sync error	SYNC signal not received within SYNC interval
	On	Bus Off	CAN controller status: Bus off

Table 67: Function of Bus LEDs

5.5.8.1 Signal States of Bus Status LEDs

The following states are displayed:

LED ON	Constant on
LED OFF	Constant off
LED flickering	On / off phase at a rate of approx. 10 Hz: ON approx. 50 ms OFF approx. 50 ms
LED blinking	On / off phase at a rate of approx. 2.5 Hz: ON approx. 200 ms OFF approx. 200 ms
LED single flash:	A single flash (approx. 200 ms) followed by a long off phase (approx. 1000 ms).
LED double flash:	A sequence of two short flashes (approx. 200 ms), the pause between two plashes is approx. 200 ms. This sequence ends with a long OFF pause (approx. 1000 ms).
LED triple flash:	A sequence of three short flashes (approx. 200 ms), the interval between the three flashes is approx. 200 ms. This sequence ends with a long off phase (approx. 1000 ms).

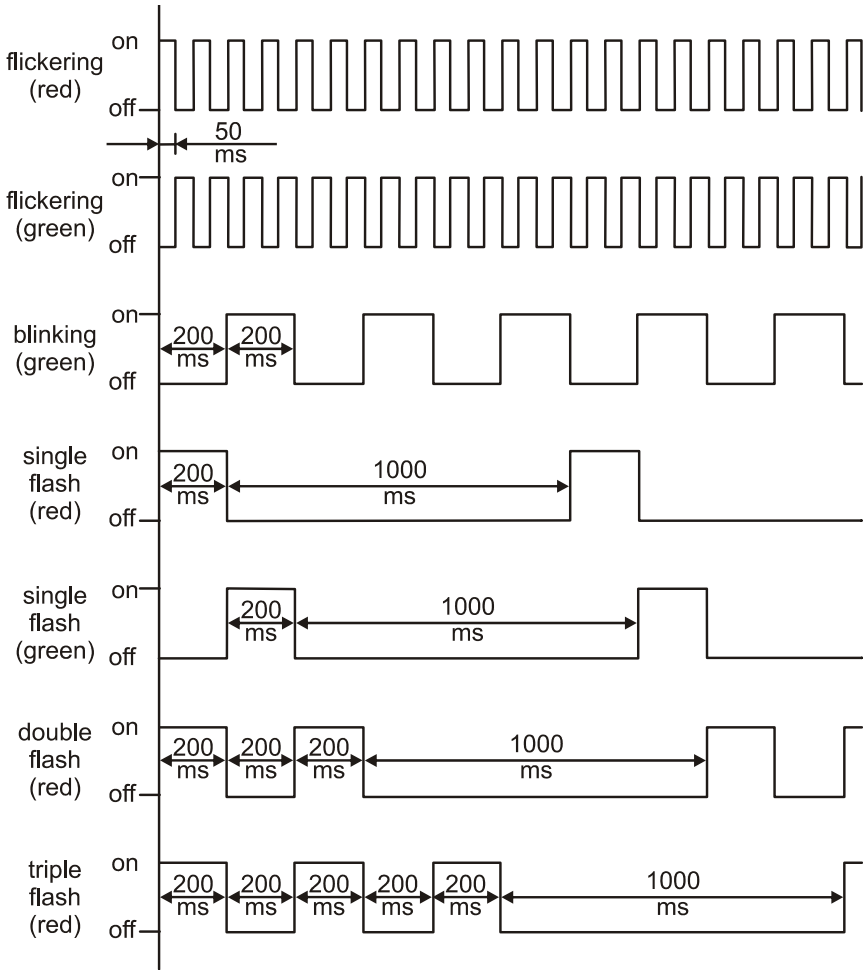


Fig. 22: Status of bus displays and flash rates

5.5.9 Diagnostics via the Fieldbus

The following diagnostics are reported:

- Sensor short-circuit as group signal
- Actuator short-circuit by channel and group signal
- Module power supply undervoltage UI (module power supply is less than 18 V).
- Actuator power supply undervoltage UA (actuator power supply is less than 18 V).

With CANopen, the diagnostics are sent in separate diagnostic telegrams. An emergency telegram (EMCY telegram) is always transmitted when an error occurs. When an error is rectified, an EMCY telegram with NO-ERROR content is transmitted.

The EMCY telegram structure is described in greater detail below.

5.5.9.1 EMCY Telegram Structure

The EMCY telegram consists of 8 bytes of data. The channel diagnostics are displayed in the manufacturer-specific section (bytes 5 to 7).

Byte	0-1	2	3-4	5	6	7
Content	For Error Code, see the table below	Error Register (Object 1001h)	Reserved	Actuator short-circuit Channels 20 to 23 (X2) Actuator short-circuit Channels 30 to 33 (X3) (Object 3000h)	Actuator short-circuit channels 00 to 03 (X0) Actuator short-circuit Channels 10 to 13 (X1) (Object 3000h)	Group diagnostic Manufacturer status register Object 1002h lower 8 bit

Table 68: EMCY telegram structure

5.5.9.2 (Supported Error Codes (EMCY Bytes 0+1)

Error Code	General Fieldbus Diagnostics	Cause
0x0000	ERROR_RESET_OR_NO_ERROR	An error was corrected
0x1000	GENERIC_ERROR	Generic error
0x6101	SOFTWARE_RX_QUEUE_OVERRUN	Internal overflow in Rx software buffer
0x6102	SOFTWARE_TX_QUEUE_OVERRUN	Internal overflow in Tx software buffer
0x8100	COMMUNICATION	Synchronization, CAN Controller in warning level Tx/Rx error counter ≥ 128
0x8130	LIFE_GUARD_ERROR	Node guard error Heartbeat error
Error Code	Device-specific diagnostics	-
0x2100	CURRENT_DEVICE_INPUT_SIDE	Sensor short-circuit
0x2320	SHORT_CIRCUIT_AT_OUTPUTS	Actuator short-circuit with GND
0x3120	INPUT_VOLTAGE_TO_LOW	Module and sensor power supply undervoltage <18V
0x3320	OUTPUT_VOLTAGE_TO_LOW	Actuator power supply undervoltage <18 V

Table 69: Supported Error Codes (EMCY Bytes 0+1)

5.5.9.3 Error Register (1001H), (EMCY Byte 2)

Bit	Meaning	Comments
0	Generic error	Generic error
1	Current	Current
2	Voltage	voltage
3	Not used	Not used
4	Communication error	Communication error
5	Not used	Not used
6	Not used	Not used
7	Manufacturer-specific	Not used

Table 70: Error Register (1001H), (EMCY Byte 2)

5.5.9.4 Channel-wise Diagnostics (EMCY Bytes 5-6)

The data displayed in Bytes 5 and 6 are described by the fault cause described in Byte 7 (manufacturer status register).

Undervoltage or failure of module / sensor power supply:

Byte	5	6	7
Content	00H	00H	0x1H

Table 71: Channel-wise diagnostics

Undervoltage or failure of actuator power supply:

Byte	5	6	7
Content	00H	00H	0x4H

Sensor short-circuit*:*

Byte	5	6	7
Content	00H	00H	10H

Table 72: Channel-wise diagnostics

Actuator short-circuit with GND:

Byte	5	6	7
Content	Actuator short-circuit Channels 20 to 23 (X2) Actuator short-circuit Channels 30 to 33 (X3) (Object 3000 Subindex 4)	Actuator short-circuit Channels 00 to 03 (X0) Actuator short-circuit Channels 10 to 13 (X1) (object 3000 subindex 3)	20H

Table 73: Channel-wise diagnostics

5.5.9.5 Manufacturer Status Register (EMCY Byte 7)

Structure of Byte 7.

Bit	Meaning	Comments
0	Undervoltage of module and sensor power supplies UI	
1	Reserved	
2	Undervoltage of Actuator Power Supply UA	
3	Reserved	
4	Sensor short-circuit US	
5	Actuator short-circuit[3]	
6 to 31	Reserved	

Table 74: Manufacturer status register (EMCY Byte 7)

[3] only if outputs are present

5.5.9.6 Diagnostics via 2nd Transmit PDO

In addition to the emergency telegram, it is also possible to transfer diagnostic data in the activated 2nd transmit PDO. The 2nd transmit PDO is deactivated by default.

5.5.9.7 Format of 2nd Transmit PDO

The 2nd transmit PDO consists of 4 bytes. The table below shows the structure of the 2nd transmit PDO.

Byte 0	Byte 1	Byte 2	Byte 3
Group diagnostic	**Channel diagnostics**		
Manufacturer status register Object 1002h lower 8 bit (Object 3000 Subindex 1)	Reserved (0x00)	Actuator short-circuit Channels 00 to 03 (X0) Actuator short-circuit Channels 10 to 13 (X1) (object 3000 subindex 3)	Actuator short-circuit Channels 20 to 23 (X2) Actuator short-circuit Channels 30 to 33 (X3) (Object 3000 Subindex 4)

Table 75: Structure of 2nd transmit PDO

6 Technical Data

6.1 CANopen IP20 Modules

	Impact20 C DI16 Art.No. 56904	Impact20 C DI8 DO8 Art.No. 56905	Impact20 C DO16 Art.No. 56906
General			
Terminals X0 and X1	16 inputs	8 inputs	16 outputs
Terminals X2 and X3		8 outputs	
EMC			
EN 61131-2	Product standard		
EN 61000-4-2 ESD	Contact ± 4 kV, air ± 8 kV		
EN 61000-4-3 RF-Field & GSM	10 V/m		
EN 61000-4-4 Burst	± 2 kV DC inputs, ± 1 kV signal lines Asym./symm. ± 500 V		
EN 61000-4-5 Surge	Asym. ± 1 kV		
EN 61000-4-6 HF-asymmetric	10 V		
EN 61000-4-8 Magnetic field 50 Hz	30 A/m		
EN 55011 Emission	QP 40 dBµV/m (30 … 230 MHz) QP 47 dBµV/m (230 … 1000 MHz) Class B		
Ambient Conditions			
Operating temperature	0°C ... +55 °C		
Storage temperature	-20°C ... +70 °C		
Enclosure type according to EN 60529	IP 20		
Mechanical Ambient Conditions			
Oscillation according to EN 60068 Part 2-6	5 … 60 Hz: constant amplitude 0,35 mm; 60 … 150 Hz: constant acceleration 5 g		
Shock according to EN 60068 Part 2-27	Amplitude 15 g, 11 ms duration		
Miscellaneous			
Dimensions (LxWxH)	117 x 56 x 47 mm		
Mounting dimension (L xW)	117 x 56 mm		
Weight	Approx. 170 g		

	Impact20 C DI16 Art. No.: 56904	Impact20 C DI8 DO8 Art. No.: 56905	Impact20 C DO16 Art. No.: 56906
Bus Data			
Transfer protocol	CAN, Layer 7 CANopen		
Transfer rates	10, 20, 50, 100, 125, 250, 500, 800, 1000 Kbit/s and automatic recognition		
Potential disconnected-ness	500 V between bus and internal logic with optical coupler and DC / DC converter		
Modes	cyclic and acyclic synchronous PDOs, asynchronous PDOs		
Communication objects	2 TxPDOs, 1 SDO, 1 Emergency-Object		
Addressing	1 to 99 with two rotary switches adjustable		
CiA e.V. Vendor ID	79Dec, 4FHex		
Connection Possibilities			
Sensor supply US	Cage clamp 2.5 mm²		-
Actuator supply UA	-	Cage clamp 2.5 mm²	
Bus connection	Sub-D 9-pin		
Inputs	4 x 4 terminal block connectors	2 x 4 terminal block connectors	-
Outputs	-	2 x 4 terminal block connectors	4 x 4 terminal block connectors
Power Supply			
Operating voltage range UI/UA	18 … 30.2 V DC		
Current consumption (only, UI without I/O)	≤ 60 mA		
Actuator current consumption over UA cage clamp		max. 8 A	
Reverse voltage protection module electronics UI	Yes		
Reverse voltage protection actuator supply (UA)	Yes	Yes	
Reverse voltage protection sensor supply US	Yes		-
Overvoltage protection	Yes (suppressor diode)		
Core cross-section	max. 2,5 mm^2		

	Impact20 C DI16 Art. No.: 56904	Impact20 C DI8 DO8 Art. No.: 56905	Impact20 C DO16 Art. No.: 56906
Inputs			
Number of inputs	16	8	-
Delay time for signal change	2 ms		-
Maximum length of input cable	< 30 m		-
Input characteristics	EN 61131-2, Type 3		-
Outputs			
Number of outputs	-	8	16
Switching frequency	-	approx. 50 Hz, 50% duty ratio	
Actuator current load	-	approx. 2 A per actuator	
Switching frequency inductive load	-	approx. 10 Hz	
Lamp load	-	max. 40 W	
Maximum length of output cable	-	with 0.75 mm² max. 10 m with 0.34 mm² max. 5 m	
Sensor power supply US			
Max. current	0.7 A		-
Short circuit protection for sensors with automatic restart	Yes		-
Reverse polarity protection	Yes		-

7 Accessories

7.1 I/O Level

➔ ***Murrelektronik offers a wide product portfolio in the actuator/sensor field. This ranges from connectors, cables, and adapters through to special-purpose requirements.***
Refer to our catalog or visit our inline shop at www.murrelektronik.com

7.2 Voltage Terminal Block

Article Number	Description
56078	Voltage terminal block gray / gray / brown / blue
56079	Voltage terminal block gray / gray / yellow / blue
56080	Voltage terminal block yellow / blue / yellow / blue
56081	Voltage terminal block brown / blue / brown / blue
56109	Voltage terminal block brown / brown / blue / blue
56110	Voltage terminal block blue / blue / yellow / yellow
56111	Voltage terminal block blue / yellow / brown / blue

Table 76: Voltage Terminal Block Accessories

7.2.1 Description

Voltage terminal blocks are small aids that assist in the simple bridging or chaining of a required level or voltage.

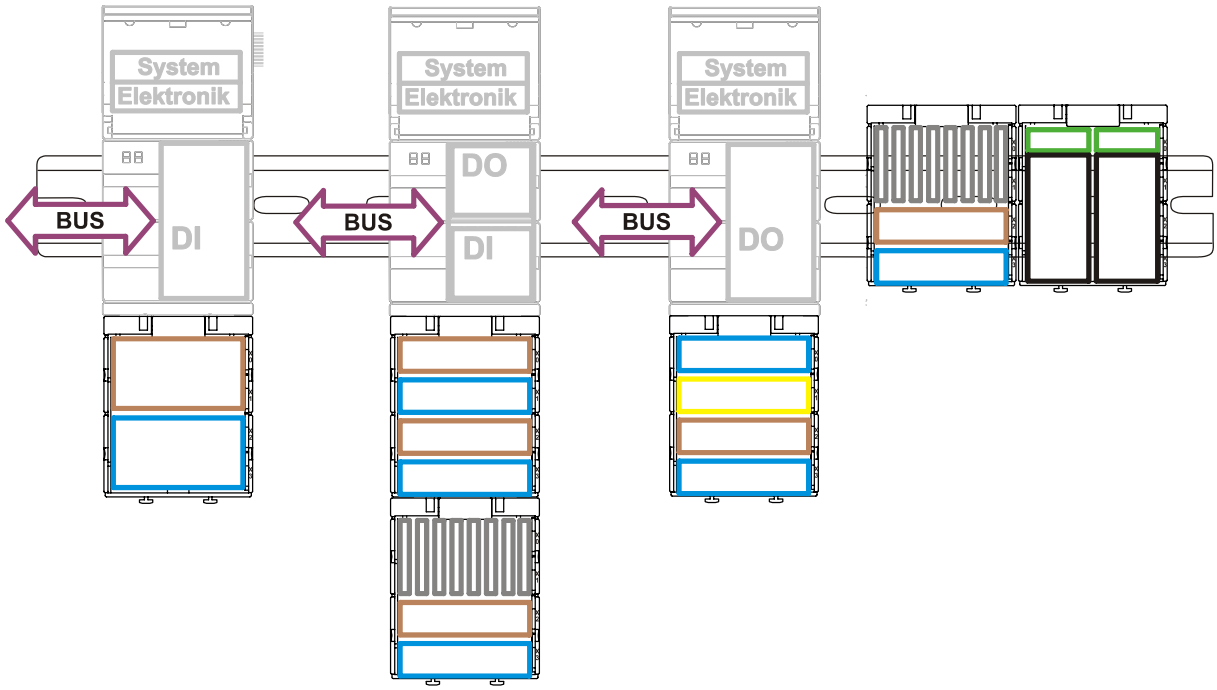


Fig. 23: Application information

7.2.2 Mounting Dimensions

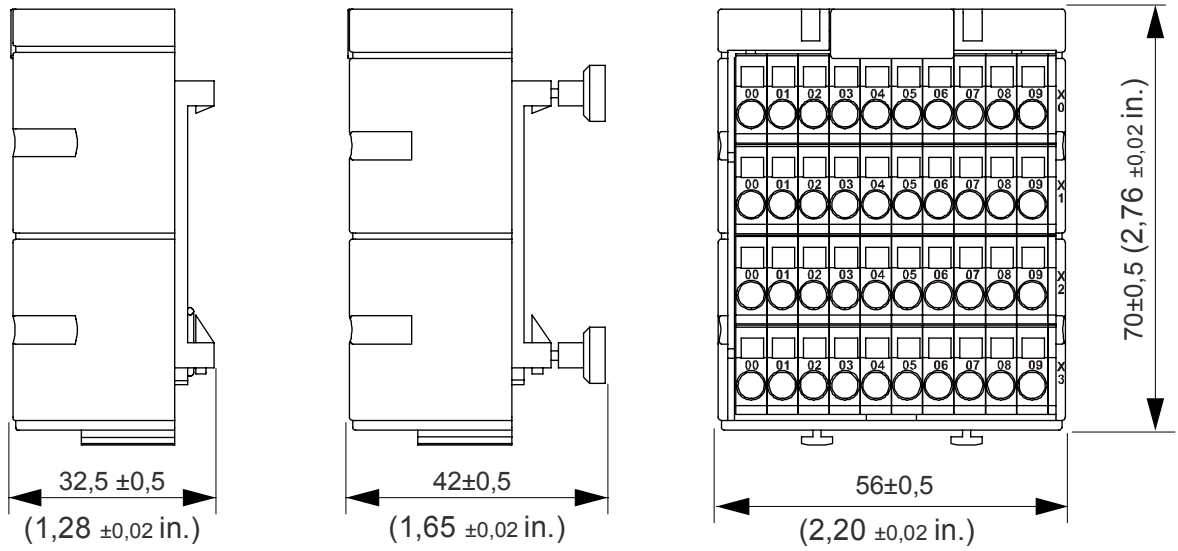


Fig. 24: Mounting Dimensions

7.2.3 Mounting Position/Distances

Einbaulage / Mounting position	beliebig / any
Abstand / Distance	beliebig / any

7.2.4 Mounting on DIN Mounting Rail and on Module

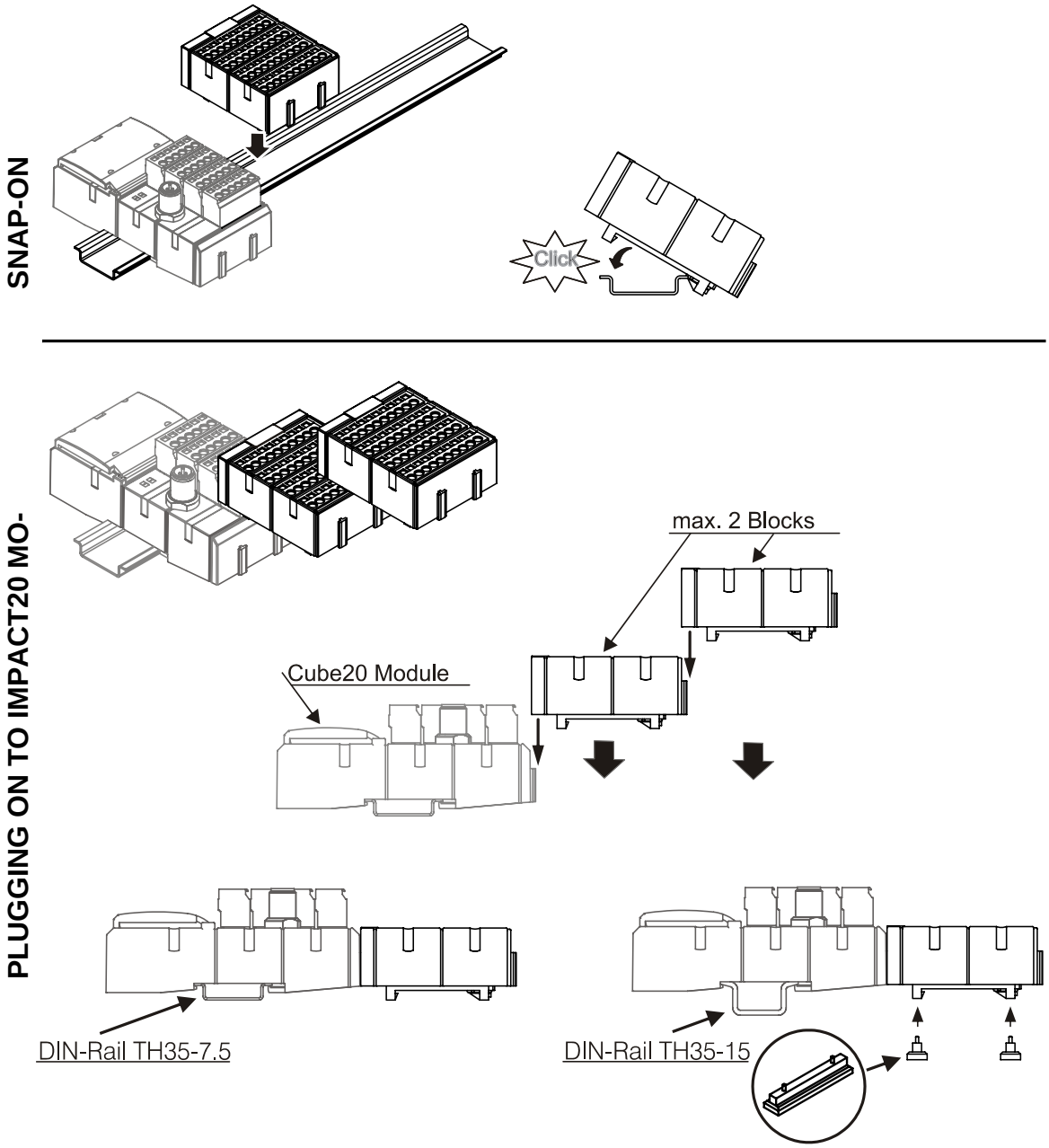
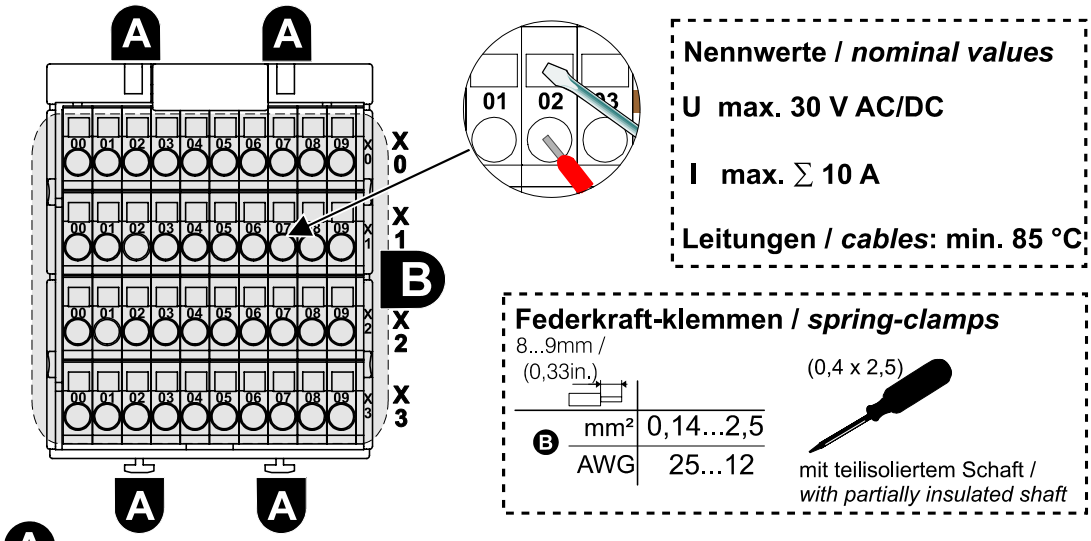


Fig. 25: Mounting the voltage terminal block on DIN mounting rails and on IMPACT20 module

7.2.5 Installation

7.2.5.1 Terminal Overview Art. No. 56078, 56079, 56080, 56081, 56084, 56109, 56110, 56111



B

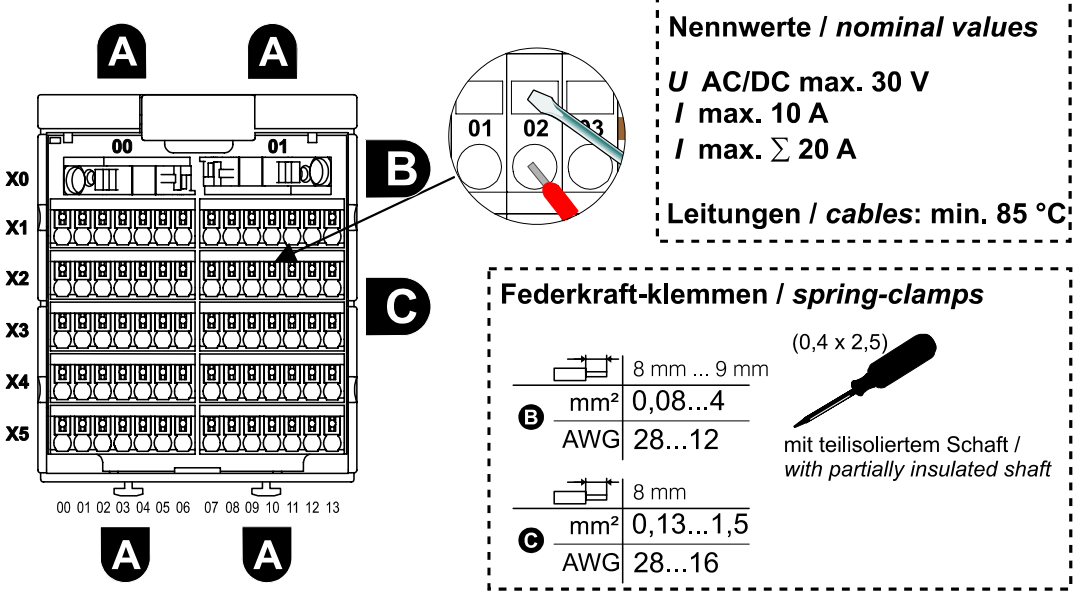
	Art.-No. 56078	Art.-No. 56079		
X0	grau / *grey*	grau / *grey*	X0	(00...09)
X1	grau / *grey*	grau / *grey*	X1	(00...09)
X2	(Us +24 V) braun / *brown*	(FE) gelb / *yellow*	X2	(00...09)
X3	(0 V) blau / *blue*	blau / *blue* (0 V)	X3	(00...09)

	Art.-No. 56080	Art.-No. 56081	Art.-No. 56084	Art.-No. 56111		
X0	(FE) gelb / *yellow*	(Us +24 V) braun / *brown*	grau / *grey*	(0 V) blau / *blue*	X0	(00...09)
X1	(0 V) blau / *blue*	(0 V) blau / *blue*	grau / *grey*	(FE) gelb / *yellow*	X1	(00...09)
X2	(FE) gelb / *yellow*	(Us +24 V) braun / *brown*	grau / *grey*	(Us +24 V) braun / *brown*	X2	(00...09)
X3	(0 V) blau / *blue*	(0 V) blau / *blue*	grau / *grey*	(0 V) blau / *blue*	X3	(00...09)

	Art.-No. 56109	Art.-No. 56110		
X0	(Us +24 V) braun / *brown*	(0 V) blau / *blue*	X0	(00...09)
X1	(Us +24 V) braun / *brown*	(0 V) blau / *blue*	X1	(00...09)
X2	(0 V) blau / *blue*	(FE) gelb / *yellow*	X2	(00...09)
X3	(0 V) blau / *blue*	(FE) gelb / *yellow*	X3	(00...09)

Fig. 26: Terminal Overview

7.2.5.2 Terminal Overview Art. No. 56082



A **Modulverbindung / *Module-connection***

B **Einspeiseklemmme / *Input terminal***

C

	Art.-No. 56082		
X0	grün / *green*	(00)	(01)
X1	schwarz / *black*	(00...06)	(07...13)
X2	schwarz / *black*	(00...06)	(07...13)
X3	schwarz / *black*	(00...06)	(07...13)
X4	schwarz / *black*	(00...06)	(07...13)
X5	schwarz / *black*	(00...06)	(07...13)

7.2.5.3 Technical Data

The IMPACT20 voltage terminal block is an expansion module for all IMPACT20 modules. It is fitted with 4 terminal rows that are electrically connected in various ways.

Art.No.	x0	x1	x2	x3
56078	gray	gray	brown	blue
56079	gray	gray	yellow	blue
56080	yellow	blue	yellow	blue
56081	brown	blue	brown	blue
56109	brown	brown	blue	blue
56110	blue	blue	yellow	yellow
56111	blue	yellow	brown	blue

Table 77: IMPACT20 voltage terminal blocks

Technische Daten / *Technical data*	
Spannung / *voltage*	AC/DC max. 30 V
Strom / *current*	max. 10 A
Umgebungsbedingungen / Ambient conditions	
Arbeitstemperatur / Operating temperature	0°C to +55°C
Lagertemperatur / Storage temperature	-40°C to +85°C
Schutzart nach EN 60529 / Enclosure type according to IEC 60529	IP20
Mechanische Beanspruchung / Mechanical ambient conditions	
EN 60068 Part 2-6 Schwingprüfung / Oscillation according to DIN IEC 60068 Part 2-6	5 g
EN 60068 Part 2-27 Schockprüfung / Shock according to DIN IEC 60068 Part 2-27	15 g / 11 ms

Technische Daten / Technical data	
Anschlussmöglichkeiten / Connection possibilities	
Federkraftklemmen / Spring-loaded terminals	
Betätigungswerkzeug / Operation tool (Wago No. 210-619)	mit teilisoliertem Schaft; / with partly insulated shaft Klinge / blade (2.5 x 0.4) mm
Anschlussquerschnitt / Terminal cross-section	0.14 mm² to 2.5 mm², AWG 25 … AWG 12
Abisolierlänge / Stripping length	8 mm to 9 mm 0.33 in.
Sonstiges / Miscellaneous	
Gewicht / Weight	70 g
Maße (L x B x H) / Dimensions (L x W x H)	

Table 78: Technical Data of IMPACT20 Voltage Terminal Blocks

7.3 Label Sheets

Article Number	Description
56113	Label Sheets

Table 79: Accessories, Label Sheets

7.4 Coding Elements for Terminals

Article Number	Description
56115	Coding Elements for Terminals

Table 80: Accessories, Coding Elements for Terminals

7.5 Fieldbus Cable

Article Number	Description
7000-00000-8039999	Bus cable for CANopen, 100 m multicolored

Table 81: BUS cable

7.6 MICO

- – Fire protection (EN 60950-1)
- – Operating voltage protection (EN 61131-2)
- – Operating state memory device (EN 61131-1)

Article Number	Description	Nominal operating branch-circuit current (full load)	
9000-41034-0100400	MICO 4.4 (4 channels)	each 4 A	
9000-41034-0100600	MICO 4.6 (4 channels)	each 6 A	
9000-41034-0401000	MICO 4.10 (4 channels)	each 10 A	
9000-41042-0100400	MICO 2.4 (2 channels)	each 4 A	
9000-41042-0100600	MICO 2.6 (2 channels)	each 6 A	
9000-41042-0401000	MICO 2.10 (2 channels)	each 10 A	

Table 82: Overview of MICO variants

Glossary

Actuator short-circuit	Short-circuit or overload at an output results in output switchoff.
BN-P	Bus Node - Profibus, bus node – Profibus.
Bus Run LED	LED to signal bus status.
Bus segment	Due to the electrical specification of the RS-485 interface, the number of users on the RS485 network is restricted to 32 users. If more than 32 Profibus users are connected, the network must be divided into segments by means of repeaters.
Byte	Equivalent to 8 bits.
CAL	CAN Application Layer. Application Layer (ISO/OSI Layer 7) specified by the CiA.
CAN	Controller Area Network
CiA	CAN in Automation e. V. Organization of CAN bus device manufacturers and users
CiA Draft Standard 102	Description of the physical CAN communication (Layer 2) for industrial applications
CiA Draft Standard 301	Description of application and communication profile for industrial systems
CiA Draft Standard 401	Description of device profile for generic input and output modules
CMS	CAN based Message Specification. A service element available to the application layer for the manipulation of objects.
CO	CANopen
COB	Communication Object. Messages are transmitted in the network in COBs and viewed as communication objects.
COB-ID	COB Identifier: Each communication object is unambiguously defined by the COB-ID. The COB-ID marks the communication object’s priority.
CSMA/CA	Carrier Sense Multiple Access / Collision Avoidance
DBT	COB-ID Distributor. A service element of the application layer; it assigns the COB-IDs to the communication objects of the CMS services.
DI	Digital Input
DIN	Deutsches Institut für Normung (German Standards Institute)
DIN TH35	Standardized DIN mounting rail (35x15 mm, 35x7.5 mm).
DO	Digital Output
DP	Decentral Periphery. Profibus protocol for the high-speed cyclic data exchange.
EDS	Electronic Data Sheets, device description file for CANopen, DeviceNet, and Ethernet/IP devices. Equivalent to the GSD file for

	Profibus devices.
EC Directive 2004/108/EC	EMC Directive.
EMC	Electromagnetic Compatibility.
EN	European Standard
ESD	Electrostatic Discharge
EEC	European Economic Community
FE	Function ground/earth.
Freeze Command	The slave input data are "frozen".
DDBF	The Device Data Base File describes the technical features of a Profibus product. This file is required to configure a Profibus system and is supplied by the device manufacturer.
I	Current.
I/O	Input/Output
ID number	A 16-bit number that identifies a Profibus product uniquely. It represents a reference for the DDB file. Several devices may also have the same ID number, provided they are describable in a common DDB file. This number is issues by the Profibus Nutzerorganisation e.V. (German Profibus User Organization).
IEC	International Electrotechnical Commission
IEC 61158	Profibus DP and FMS standard valid worldwide. Successor of international standard EN 50 170 Volume 2.
IP20	Ingress Protection Protection type as per DIN EN 60529 1st digit = protection against contact and foreign bodies 2nd digit = protection against water 2: Protection against the ingress of solid foreign bodies above a diameter of 12.5 mm, protection against access by finger 0: No protection against inclusion
ISO	International Standard Organization
LED	Light Emitting Diode
LMT	Layer Management. Enables the setting of layer-related parameters to a node.
LSB	Least significant bit.
FO	Fiber optics, optical fiber.
MS	Module status
MSB	Most significant bit.
Ni	Nickel.
NMT	Network Management. NMT provides services for initializing and monitoring the nodes in a network.
NS	Network status

OSI	Open Systems Interconnection
PAA	Process map of outputs
PAE	Process map of inputs
PDO	Process Data Object. Object for process data exchange between various devices.
PELV	Protective Extra Low Voltage.
PNO	Profibus Nutzerorganisation e.V. (German Profibus User Organization)
Repeater	Coupling element to process signals between Profibus segments.
RTR	Remote Transmission Request. Request for data using the same identifier as used for data transmission.
SDO	Service Data Object, Objects for access and manipulation to data in the object directory
SELV	Safety Extra Low Voltage.
Simatic Manager	Programming software for program-logic controllers made by Siemens.
PLC	Program-logic controller
SYNC	Synchronization object
U	Voltage.
U/I	Voltage / current
UA	Actuator power supply
UI	Module and sensor power supply.
US	Sensor power supply.
VDMA	Verband Deutscher Maschinen- und Anlagenbau e.V. (Association of German Machinery and Industrial Equipment Manufacturers)
VZ	Sign (+ or -)
ZVEI	Zentralverband Elektrotechnik- und Elektronikindustrie e.V. (German Electrical and Electronic Manufacturers' Association).

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